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Don't Shoot the Dog—Help Him as if He Were Human

IF some cats and dogs were not dumb they would undoubtedly get up a testimonial to Dr. George W. Little to express their gratitude to him for introducing a substitute for ether—a substitute which enables them to withstand operations that are particularly hazardous when performed under ether.

Although because of lack of imagination animals do not suffer mentally as do humans when facing an operation, it is impossible to perform a serious operation with the aid of a local anesthetic. Dr. Little, therefore, set about to find some anesthetic which would render the operation painless to the animal, would not affect its heart action and would not cause it to suffer from shock. He has succeeded by adapting to his uses the gas anesthetic used by dental surgeons.

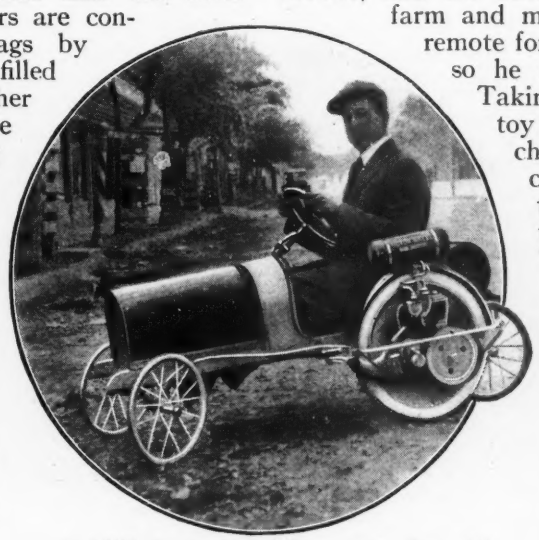
The machine which Dr. Little employs in his work in the Animal Hospital in New York city, conducted by the American Society for the Prevention of Cruelty to Animals, consists of two cylinders, one containing nitrous oxide and the other oxygen. The cylinders are connected with two bags by tubes. One bag is filled with the gas, the other with the oxygen. The outlet of each bag passes into one tube connected with the mouthpiece that is attached to the patient's nose. The proportions of the gas employed may be regulated by means of valves.

The dog or cat in need of an operation is placed on the operating table and the mouthpiece adjusted over its nose. The nitrous oxide gas is turned on. In a short time the animal loses consciousness. It is then given a little oxygen to sustain its heart action. With the use of oxygen which the surgeon administers at his discretion, the patient may remain under the anesthetic for hours.

During the operation the animal feels no pain whatever. When it comes out of the unconscious state it is able to walk to its ward in the hospital and apparently feels no ill effects at all. The new anesthetic has been particularly successful when given to old dogs which suffer from tumors. With the use of ether for such a serious operation an aged dog has very little chance for recovery.

Converting a Discarded Toy into a Real Automobile

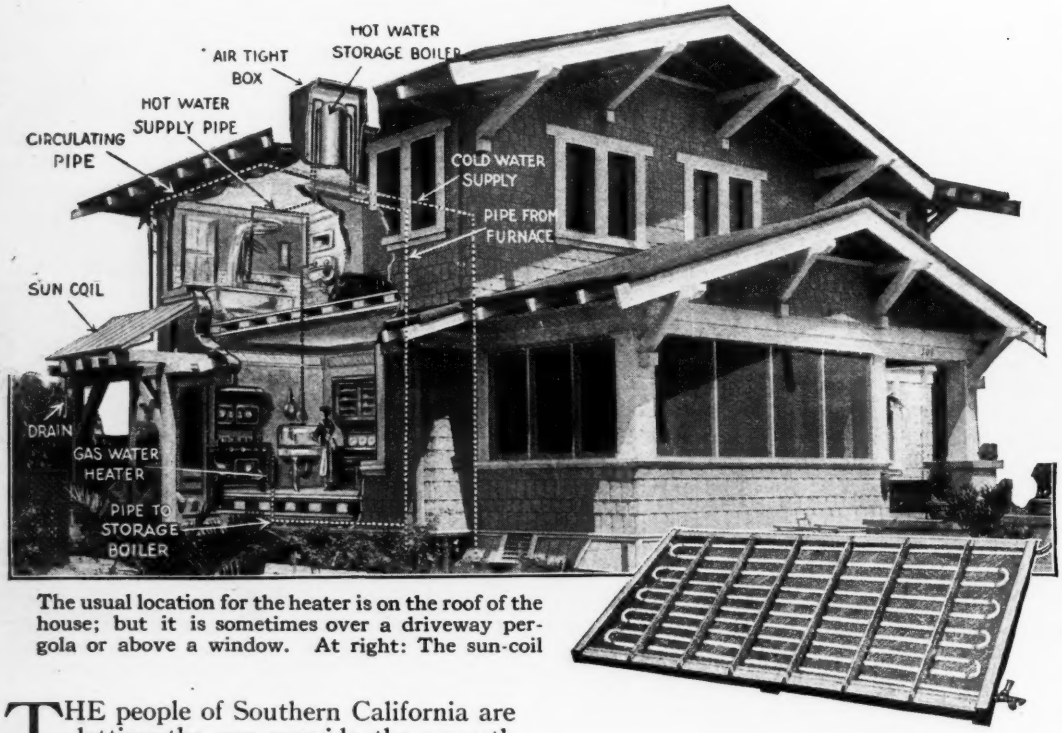
THAT all the ingenuity in the automobile line is not confined to the workers in the big factories, where the various makes of big cars are produced, is evidenced by this picture. This boy, down in Texas, where the prevailing ambition is to own a farm so it can be mortgaged for an automobile, had the auto-bug himself. The farm and mortgage seemed too remote for his earnest longing, so he made his own car. Taking an old, battered toy automobile that some child of wealth had discarded, he attached thereto the little motor from a bicycle. The hood he improvised from part of an old wash-boiler. The steering apparatus he made himself. When the machine was complete it made the trip to town, a distance of several miles in fairly good time for its size. It is still giving service.



A child's toy automobile, a part of an old wash-boiler and a small motor are the component parts of this little machine

Putting the Sun at Work in the House

All that is necessary is to expose the pipes so that the genial rays can reach them. There is no charge for service



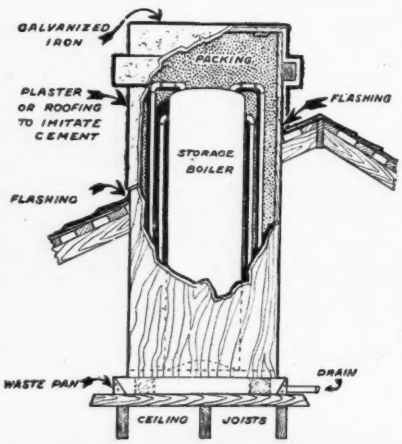
The usual location for the heater is on the roof of the house; but it is sometimes over a driveway pergola or above a window. At right: The sun-coil

THE people of Southern California are letting the sun provide the warmth whereby the water they use is heated.

The device by which it is done is known as the "solar heater." It consists of a shallow box about four inches in depth, within which is a coil of galvanized water pipe. The box is covered with glass and is practically air-tight. A sheet of copper is placed behind and attached to the water pipes for the purpose of concentrating all of the sun-heat falling upon an area several times larger than that offered by the pipes themselves, thereby making the water correspondingly hotter.

The pipes of this heater are arranged with a certain upward pitch so that the heated water gradually passes from the coil to the storage-boiler. As the hot water leaves the coil its place is taken by the coldest water from the storage-boiler. During warm, sunny weather the water that was first heated and sent to the storage-boiler will return to the sun-coil to be heated to a still higher temperature. This storage-boiler is encased within a wooden box and the space between the boiler and the sides of the box is filled with a heat-retaining packing. The loss of heat by radiation is very slight. Assuming that no water is drawn, the loss of heat due to radiation during the night will vary from four to ten degrees. Hence, hot water can be drawn in the early morning as well as at the close of a sunny day. From this tank the heated water passes to the various fixtures of the home.

When the sun fails to shine a gas-heater is used.

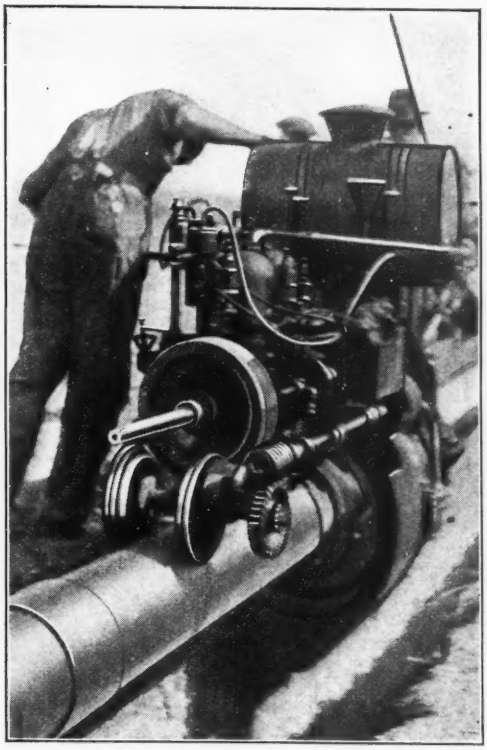


The storage-boiler is encased in an insulated wooden box

Painting Piping by Machine

OUT in California a one hundred-and-seventy-mile pipe-line was thoroughly cleaned and painted without so much as a single dab from a hand-paint brush recently.

Two machines of somewhat different type were used, one for cleaning and applying the priming coat, the other for applying the coat of bitumastic enamel. The cleaning and priming machine carried a scraper and revolving bristle brush on the front end, while the brushes for applying the paint followed on the rear end, the paint being forced to the outer edge of the brushes by centrifugal force. The entire equipment was self-contained, the six-horsepower gasoline engine which provided motive power revolved all the brushes, and the engine frame carried three tanks, for water, gasoline and paint.



A six-horsepower gasoline engine operated the scraper and revolved the brushes

A crew of two men operated the first machine, which was attended by three other men operating a long lever mounted on wheels. With this lever the pipe was raised from the four by six inch wooden skids across the trench provided by the pipe-screwing crew, and as the priming machine moved ahead the skids were replaced behind it.

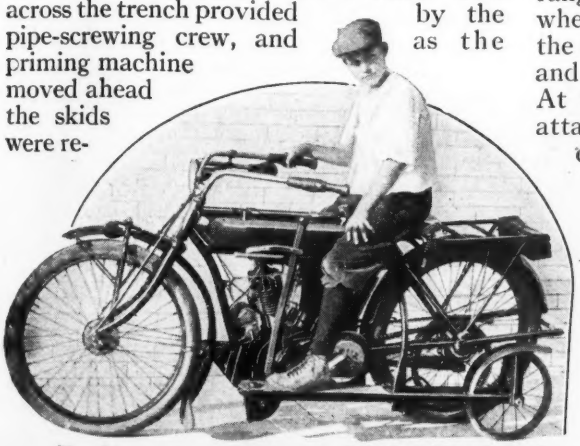
No less than two hours behind the priming machine and not more than four hours later, the enameling machine went over the line.

This machine was operated by hand, by turning a crank which caused it to move along the pipe. Large kettles mounted on wheels were used for serving the machine with melted enamel, the kettles being heated by petroleum distillate fuel. After being placed, the enamel coating was retouched where necessary and finally subjected to a rigid inspection, in which a mirror was used for examining the underside of the pipe.

There Is No Danger of Falling from This Motorcycle

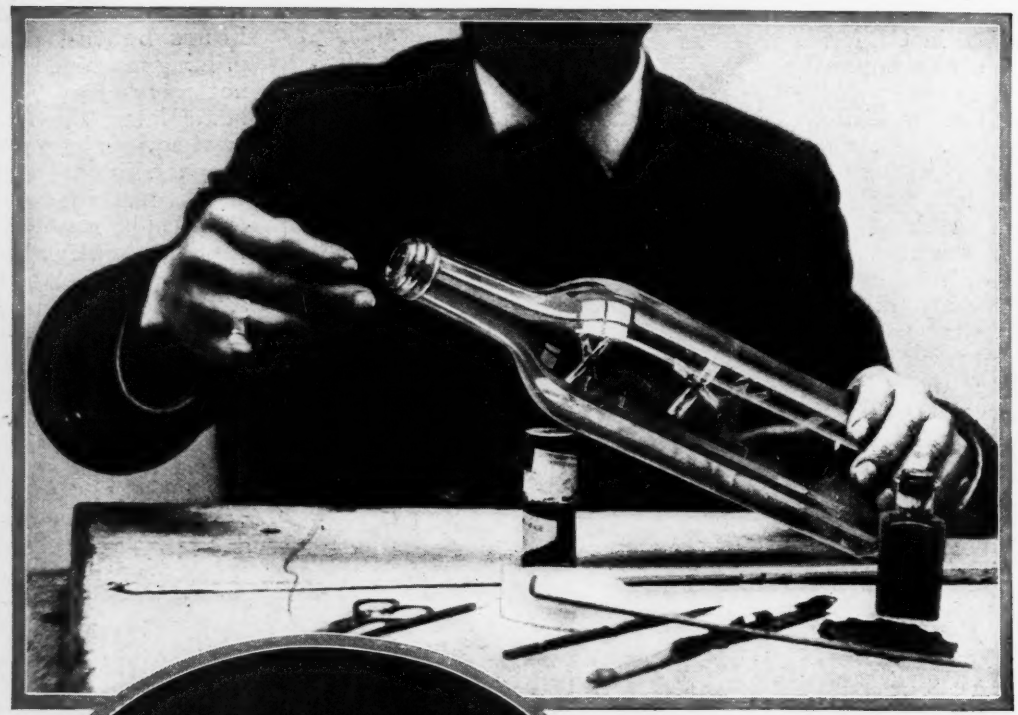
THE usefulness and the pleasure derived from a motorcycle may be increased by a stabilizer which makes motorcycle riding as simple a thing as riding an automobile. Incidentally such inconveniences as having to lift the stand on and off every time one stops are eliminated. The arrangement is very simple, consisting of a wheeled frame mounted on both sides of the motorcycle. These are pivoted in front and carry their strong wheels at the rear. At the middle of each an upright bar is attached which leads into a piston-and-cylinder mounted under the seat.

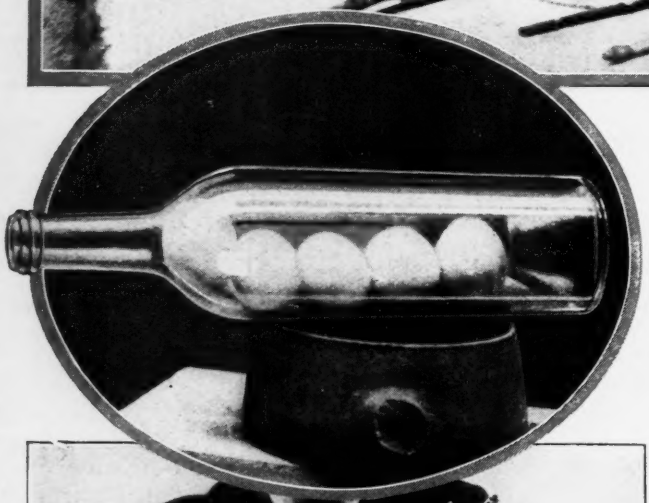
When going over rough roads the piston will allow the wheels to spring up and down, but as soon as the motorcycle leans over too far, and is about to fall, the piston stops and holds the wheels fast so that the cycle cannot really lose its balance. The credit for this arrangement belongs to its patentee, Mr. Joseph A. Blondin, of Los Angeles, California, to whom motorcyclists may desire to present a life-saver's medal.



Should a motorcycle start to fall the side-wheeled frames would remain upright and prevent a spill

Bottle Tricks—Old and New



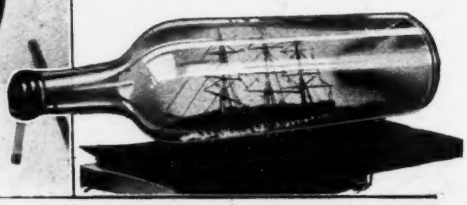


The uninitiated might sit a long time examining the bottle in the picture above to find a false bottom through which the crosses were inserted. The secret lies in the fact that the arms of the cross are adjusted after insertion

If you let an uncooked egg stand in vinegar for about twenty minutes, you can elongate it enough to get it into a small-necked bottle. Pour in cold water and the egg will return to its original shape

At left below is shown the manner of straightening out the crosses until they are as easily inserted as an ordinary stick would be. A pull on an attached string will restore them to the proper shape after they are inside

The ship in the bottle below is inserted in the same way. Hold the string in the hand and the weight of the ship will cause the adjustment



Not Buried—Only Encrusted in Snow

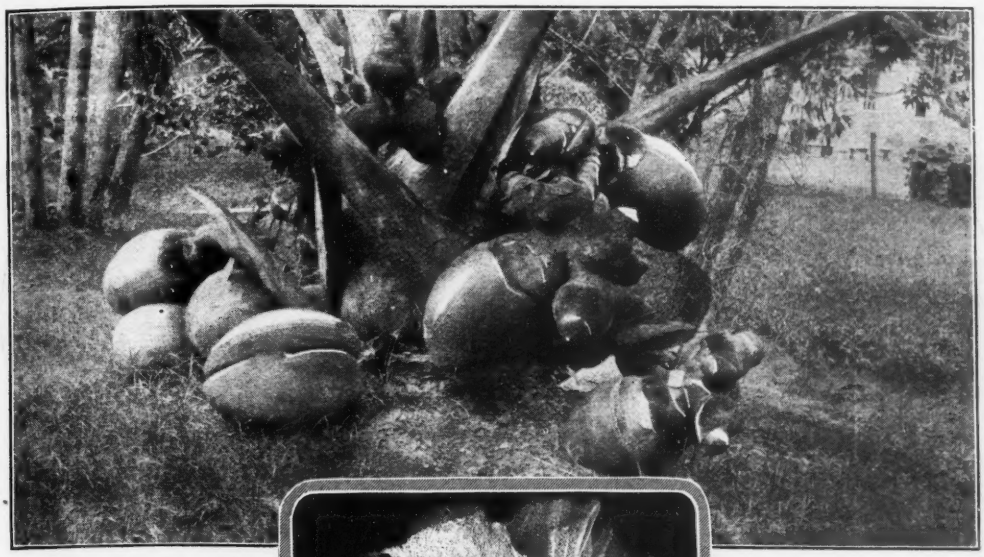
The remains of what was once a solid snow bank. The men are not standing in the snow. Their feet are in the water of a running brook, and the snow about their bodies is the hardened crust. The little brook has melted the snow until nothing remains of the original bank but a crust. Crusts of this kind, formed in extreme weather, are sometimes strong enough to support the weight of a man, but the one in the photograph was so soft that the men plunged through it to the water below

Comfort and Safety for the Man Overboard

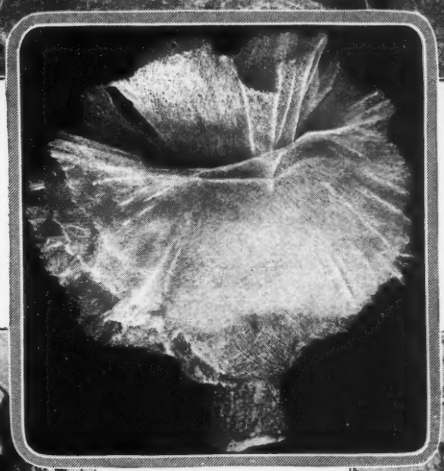
Above and at right: A new type of life-preserver, invented by O. A. Youngren. It is bulky and voluminous but is guaranteed to keep its occupant afloat and comparatively warm. It is provided with a shrill air-whistle for summoning aid. The arms fit into sleeves so that the wearer may swim if he can. The suit is of rubber, padded with cork

Below: Another all-enveloping life preserver, invented by Nick K. Ramos, of Lansing, Mich. It is donned as shown at right, below, and has a pocket-book fastening. It is provided with air tubes, observation windows, a cork framework inside the rubber cloth, and a convenient tow line

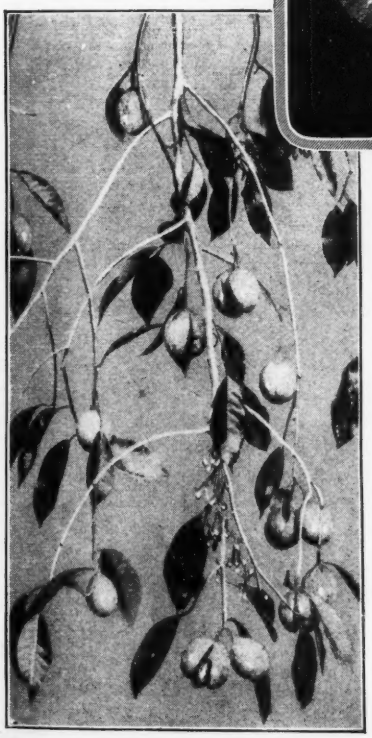
Where the High Cost of Living Is Unknown



Above: There are times when Nature seems unduly prodigal. The ordinary coconut is meaty enough and almost too rich for food; but these giant specimens grew in pairs like Siamese twins

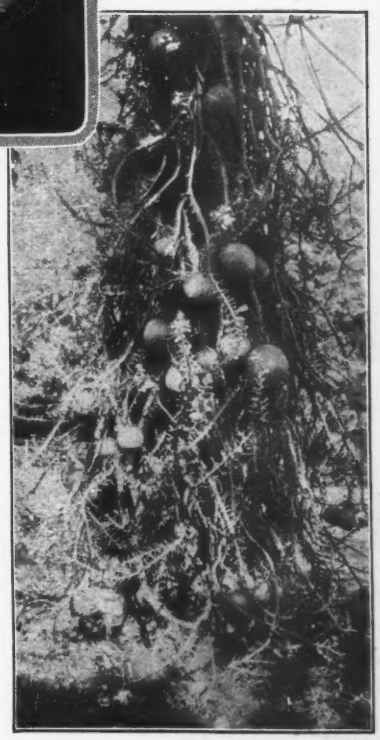


At left: A fungous growth found on trees. It resembles ruffles of fine lace or stiffened netting as delicate and beautiful as any employed on women's apparel and has no known excuse for being

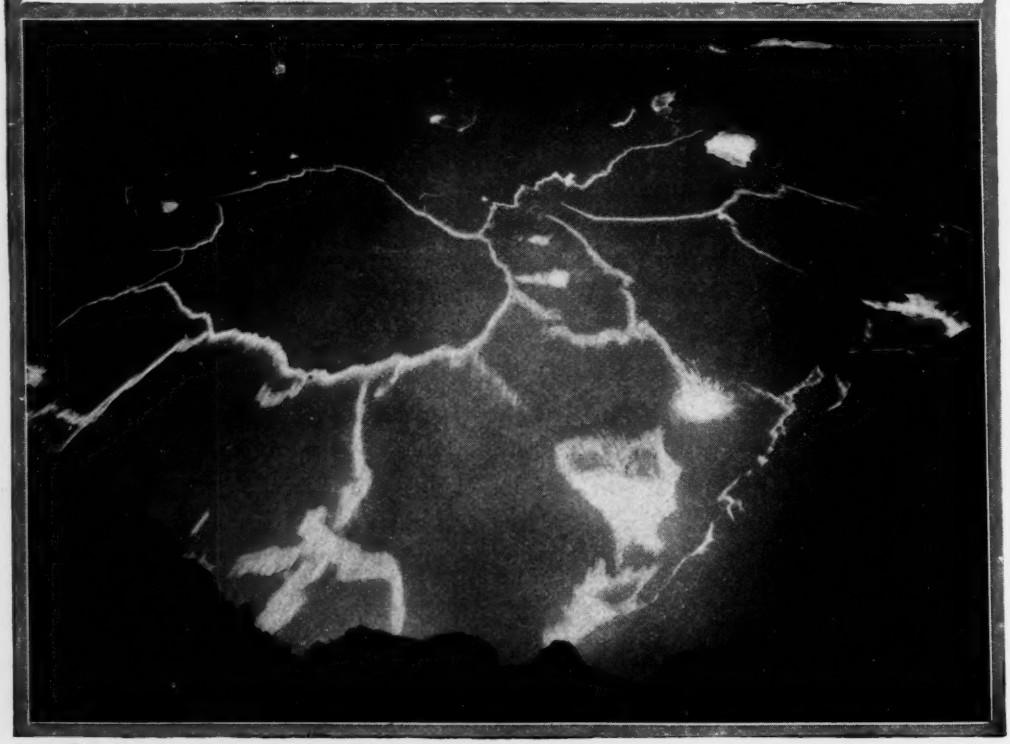


At left: The probable reason why the nutmeg is among the cheapest of commodities is that it grows in such profusion. The kernels are encased in shells like chestnuts which open up when ripe

At right: A vegetable product of the tropics which resembles cannon balls growing on climbing vines but which contain a luscious pulp on which the natives feast



Above: A section of Holemaaman, the active part of the Kilauea crater, in Hawaii, photographed at three o'clock in the morning by the glow of its fiery contents. The crater contains about twenty acres of molten lava, numerous fountains of which are continually shot up into the air to a height of from ten to eighty feet. Below is a photograph taken looking down into the crater

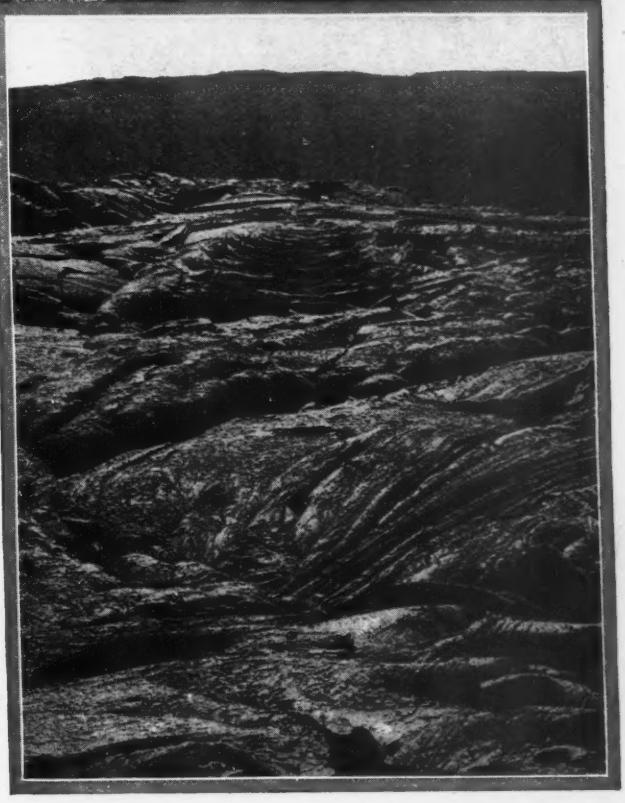


Photos © Brown and Dawson

Holemaaman, or "Home of Everlasting Fire"

Photos © Brown and Dawson

Above: A daylight view of the surface of the Kilauea crater in Hawaii, which is nearly nine miles in circumference and has thousands of crevices and gorges through which steam and smoke are constantly pouring forth. These monster firepots bring vividly to mind portions of Dante's Inferno and certain disquieting Biblical passages



Lava formations in the Kilauea crater. The lava flows out in streams sometimes miles in length, its texture being influenced by the manner of cooling. Rapid cooling produces a glass, while slow cooling results in a crystalline rock. When the lava is full of expanded gases the cooling produces a cellular tissue similar to pumice

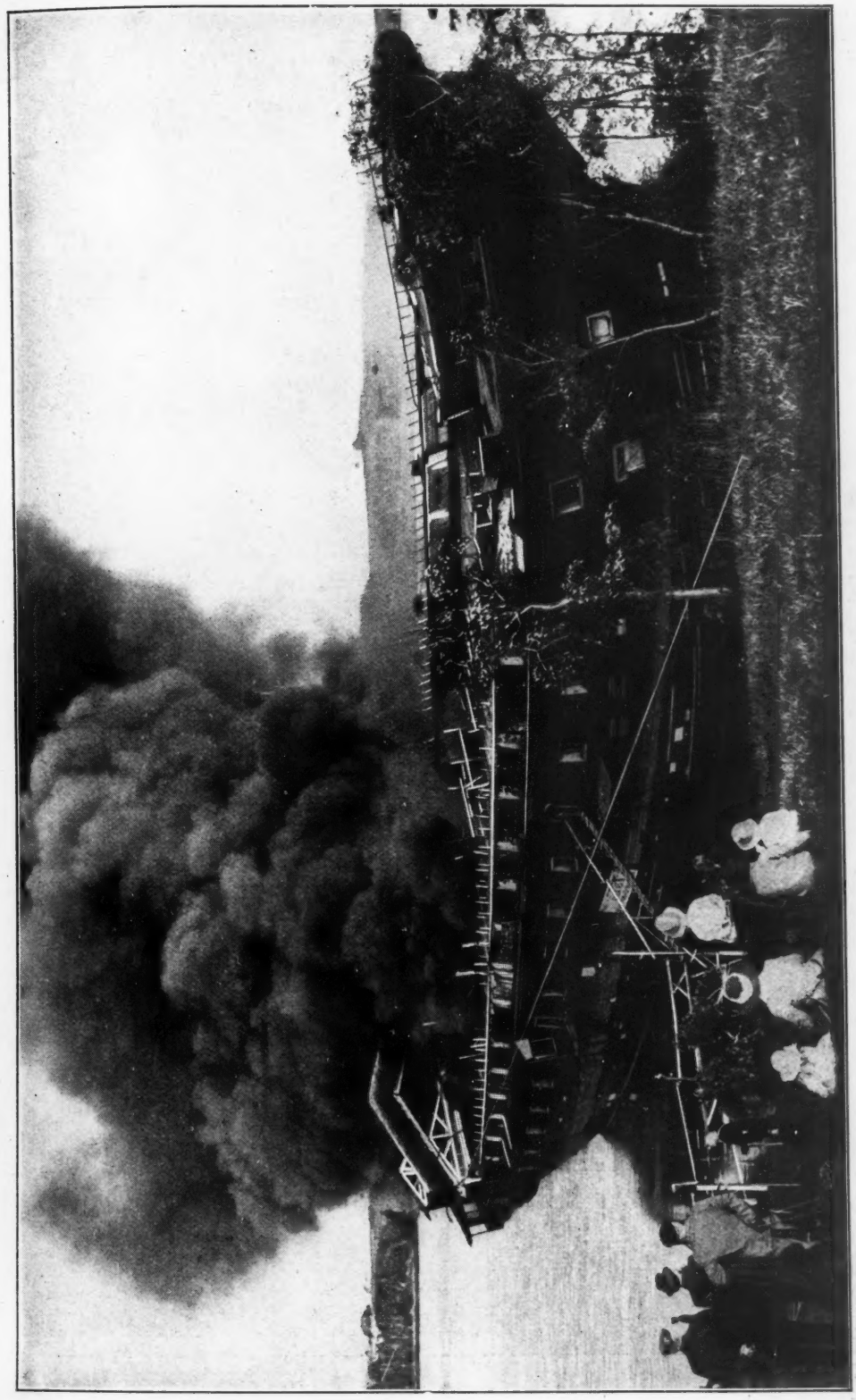
Note Your First Impressions of These Photographs

Photos © Central News Photo Serv.

Above: A British despatch rider, one of a squad picked for speed and endurance, who carry orders from headquarters to widely separated points on the firing line. So fast is this man traveling downhill that his machine seems to be floating in mid-air. He is really on a road

Not a beautiful short-skirted lady nor an inmate of a harem but one of the officers of the British army in India where the soldiers go veiled as a protection against the mosquitoes and flies, which are believed to spread malaria and yellow fever

The End of One of Farragut's Old Flagships



© Int. Film Serv.

The Frigate Franklin, Admiral Farragut's flagship, sixty-one years old, was burned at Eastport, Maine, recently by a salvage company to regain the copper in her hull. The Hartford, another famous flagship of Farragut's, is still in service as a freighter

The Lion and the Lamb Lie Down Together

In toyland the difference between the pedigreed pup and the mongrel is slight. With a few deft touches a placid nondescript is changed into a ferocious beast

Whatever may be the end of the little cloth dog it begins life wrong side out. The turning of the hide is a delicate task in which an upright standard is of great assistance

The internal organs of toy animals are all alike, whether they be lions, tigers, or just harmless puppies. They are nothing but stuffing, as the picture below shows

At the extreme right of the illustration below, a youthful artist is establishing the individuality of a specimen with a brush. His imagination is allowed full sway

Photos © Press Illustrating Serv.

On the Tables of the "Santa Claus" Workshops

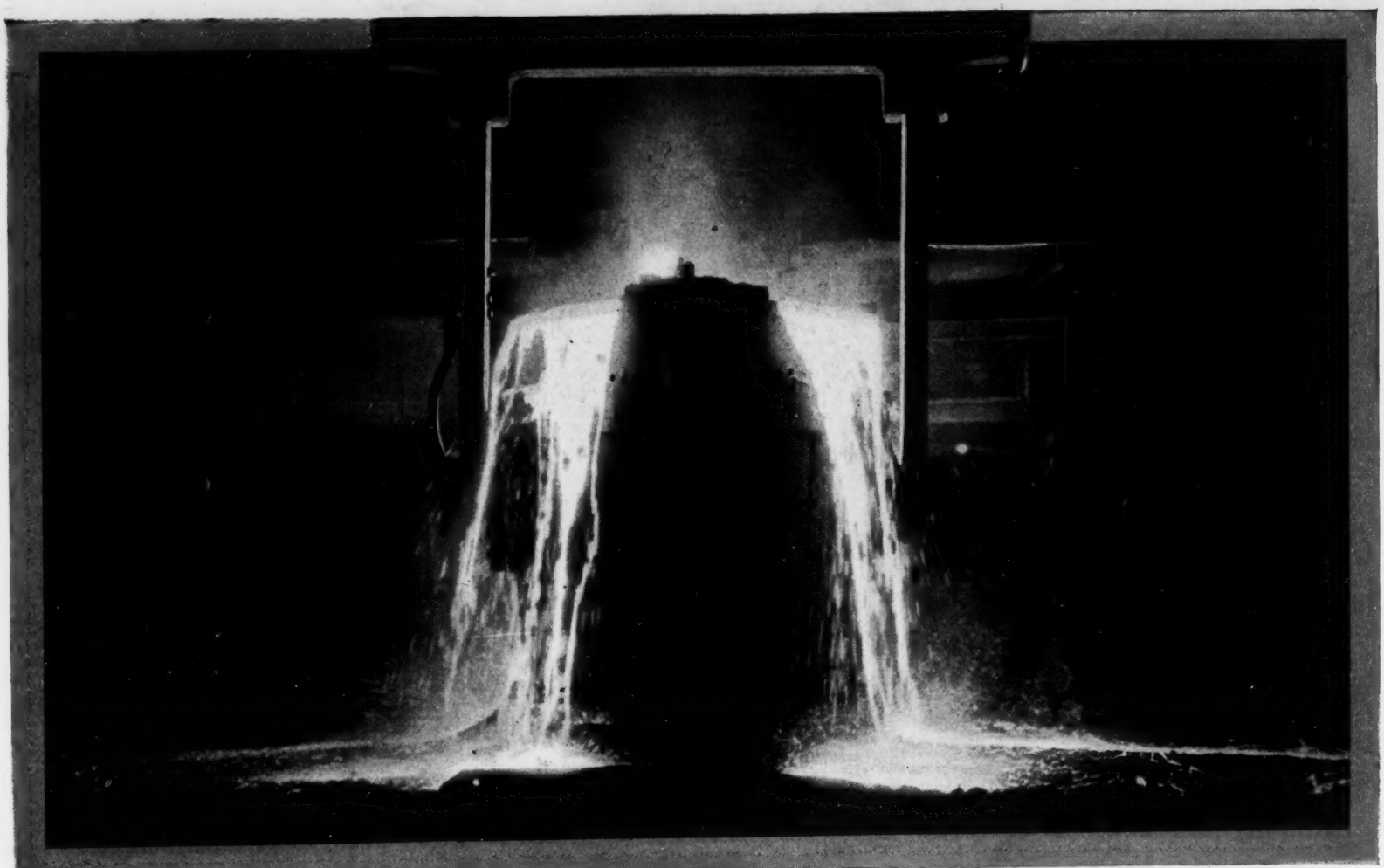
Photos © Press Illustrating Serv.

The finishing touches require a needle and thread. In the workshop the treatment which is accorded the future guardians of the nursery is little short of ignominious

On the right a row of finished animals take the center of the stage. They have passed through dozens of hands in preparation but have emerged thoughtfully triumphant and ready for their royal duties

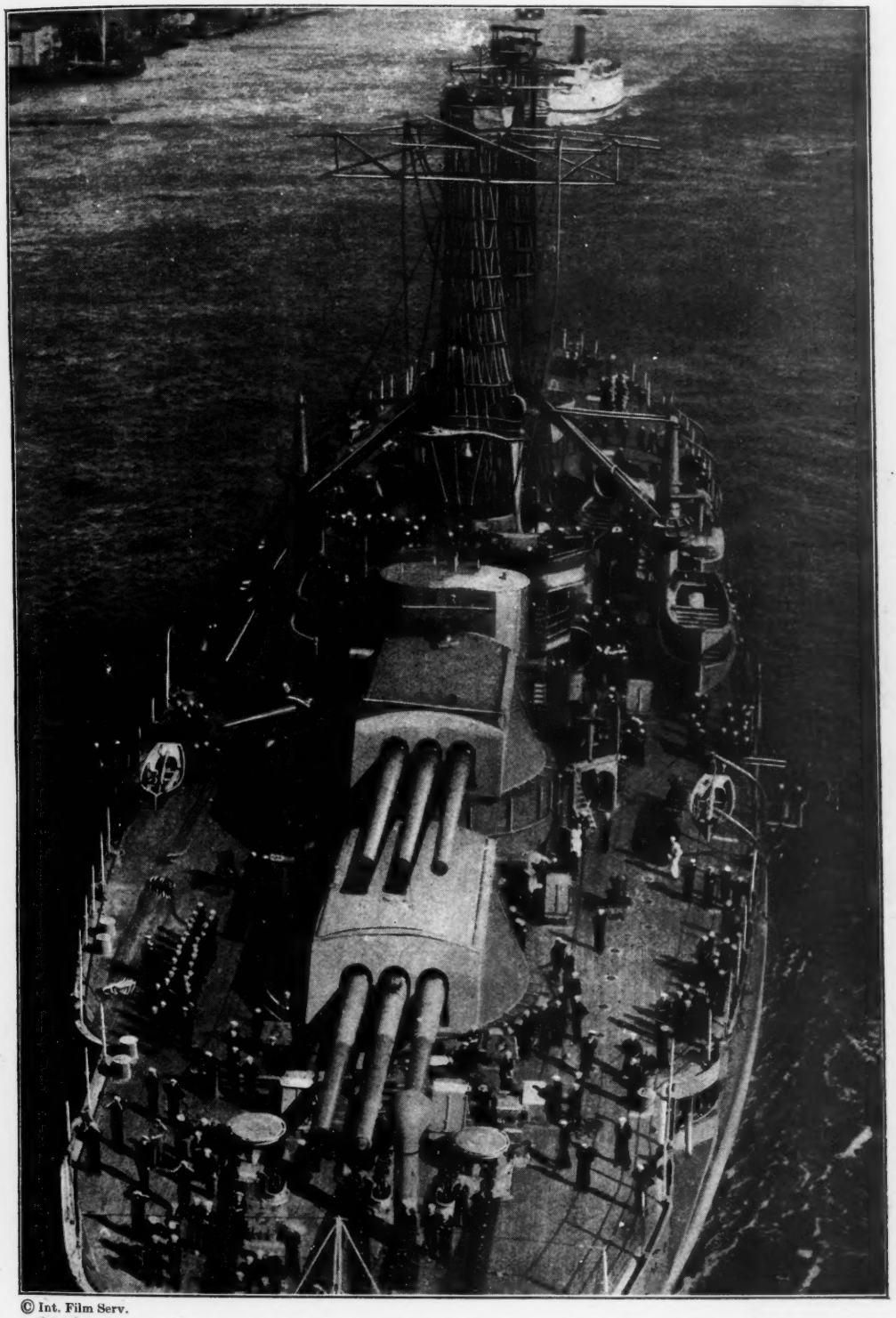
It might appear that the internal stuffing is rammed in without rhyme or reason, but in reality a systematic plan is carried out and skill is required to produce the correct shape and smooth finish

A Monster Gun in the Process of Making



This photograph was taken by the light emanating from the incandescent molten metal out of which a modern monster gun is being made. The ladle carries fifty tons of the metal, which is allowed to overflow continually so as to remove superfluous impurities and slag automatically. The framework over and around the ladle is the electric hoist by which the immense weight is lifted and transported from one process to the next

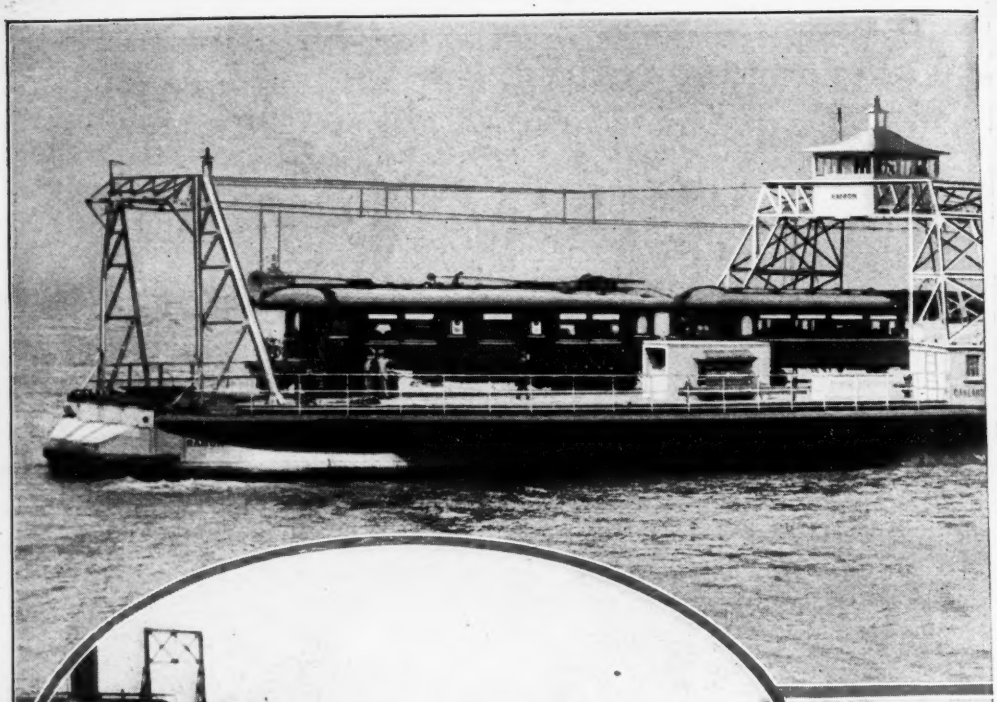
The Superdreadnought Pennsylvania

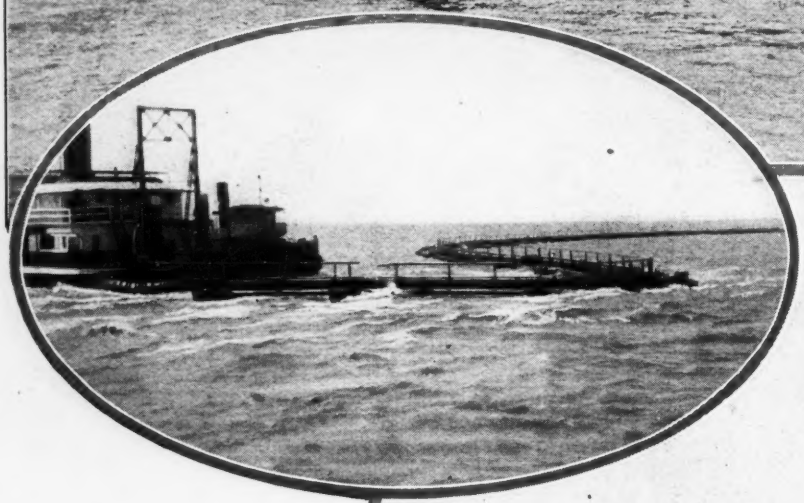


© Int. Film Serv.

The new flagship of the Atlantic Fleet is equipped with twelve fourteen-inch guns mounted in the three-gun turrets. Each gun can penetrate sixteen inches of armor at six miles. At twelve miles the Pennsylvania scored eight hits out of twenty-four—probably a world's record. The ship displaces thirty-two thousand tons

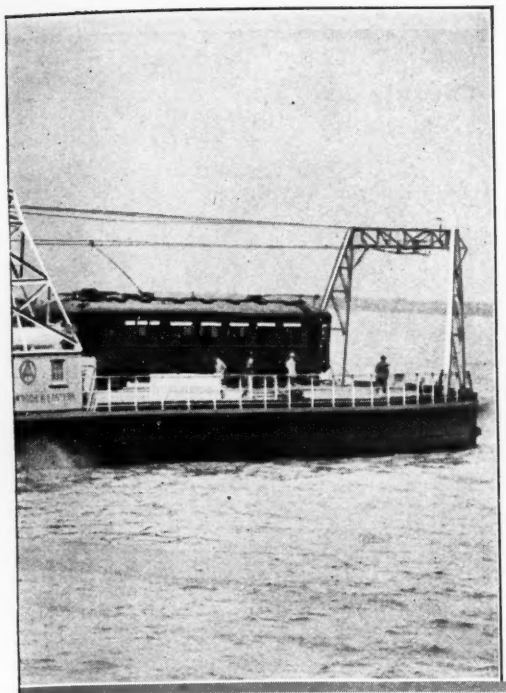
The framework over and around the ladle is the electric hoist by which the immense weight is lifted and transported from one process to the next





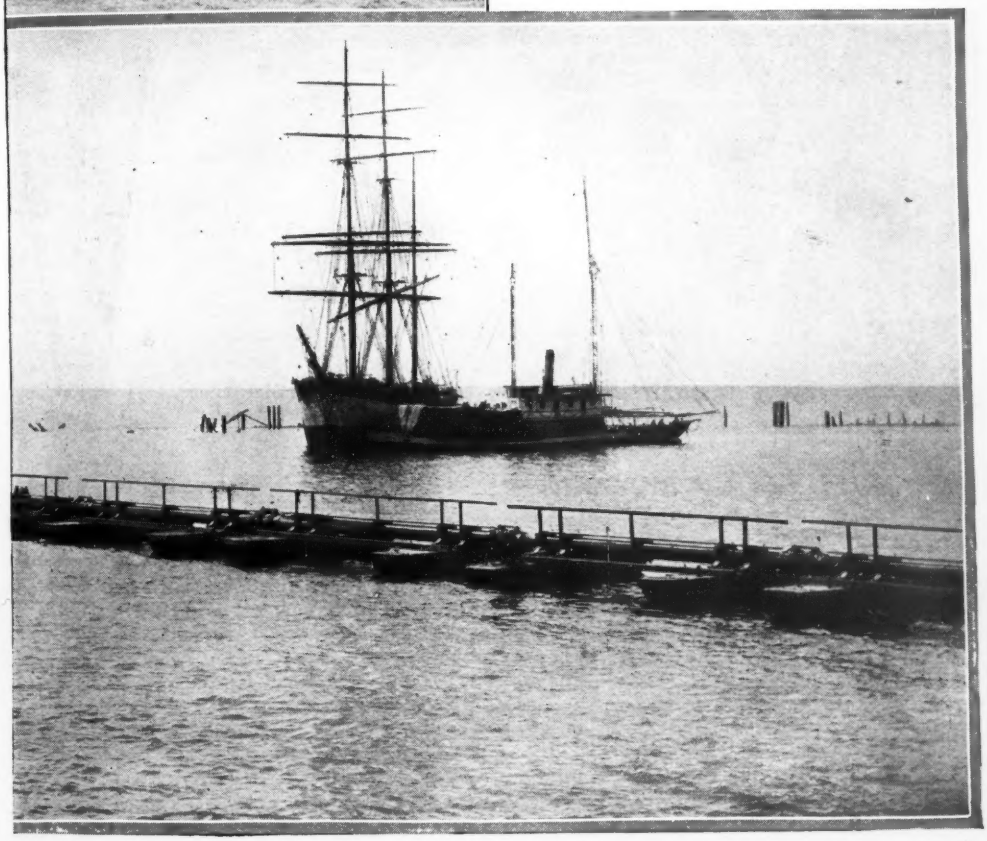
One of the most important duties devolving upon the engineer corps of the United States Army is the dredging of channels and harbors, because the ocean bottom is constantly shifting and debris of all kinds is settling in navigable inlets. In the Mobile, Ala., district, there are three outer bar channels where seagoing dredges work, and eight inner channels where pipe-line dredges are used, one of which is the Wahalak, illustrated in the oval above and in the continuous picture on the right

Scouring As Employed on the Water

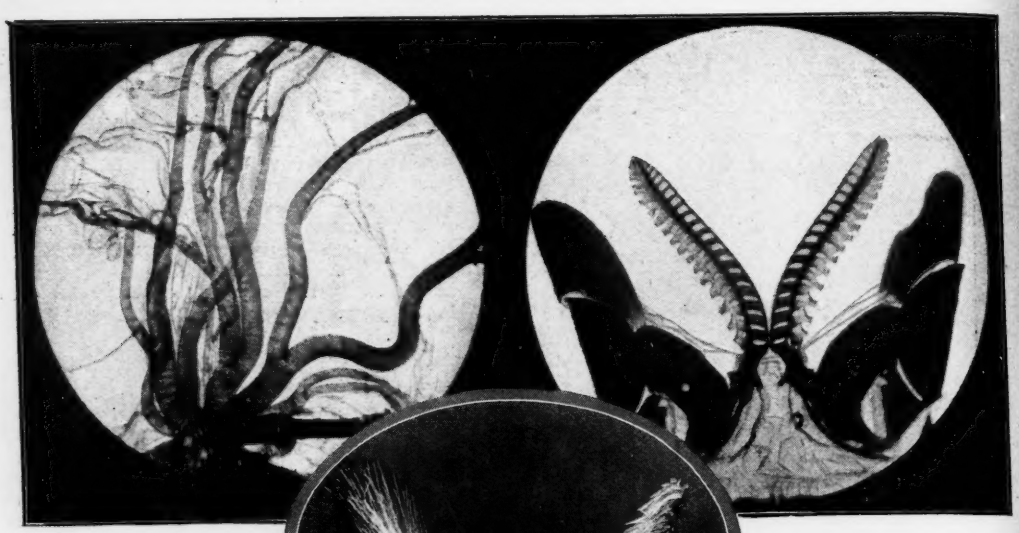


To avoid making passengers change cars in order to cross Suisun Bay, Oakland, Cal., a railway company operating between Oakland and Sacramento transports its trains, loaded with passengers, across the bay on a gasoline-engine driven ferry (illustration on the left continued from preceding page). The car ferry is known as the Ramon. It has carrying capacity for six loaded passenger trains or eight freight trains

Below: A continuation of the picture of a floating pipe-line used by the engineer corps for dredging channels and harbors. The dredge draws the sediment from the bottom, sucks it into the pipe-line and then pumps it through the line to the point of discharge which is miles out at sea. The average length of the pipe-lines is twelve hundred feet. The pontoons are designed to offer a minimum resistance to waves and tides



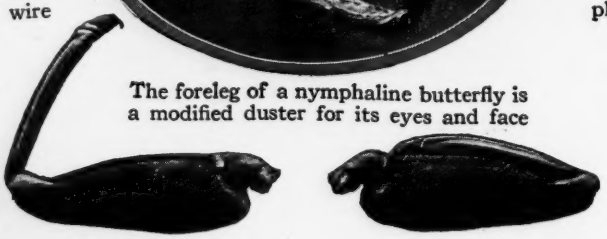
Are There Inventors Among the Insects?



The breathing tubes, or trachea, of insects closely resemble our rubber tubing lined with coiled wire

One species of fly has wonderful twin saws with which it cuts slits in plant tissues as hiding places for its eggs

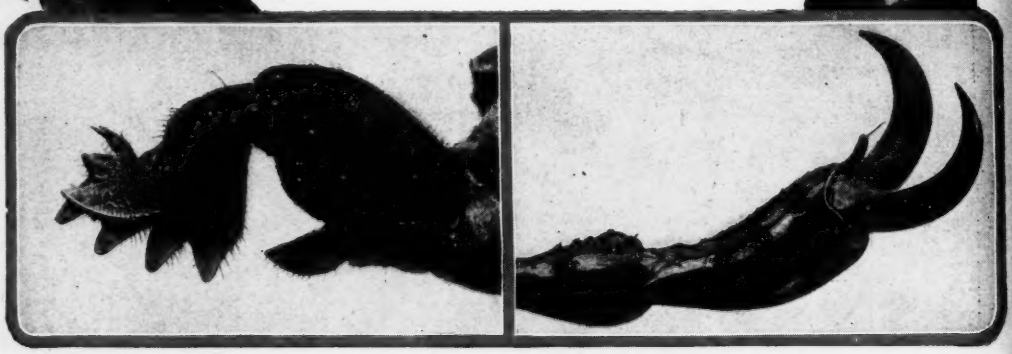
The foreleg of a nymphaline butterfly is a modified duster for its eyes and face



The foreleg of an electric-light water bug opens and shuts like a jackknife, as shown above

At left: The web-nest of the trap-door spider which probably employed the very first hinge

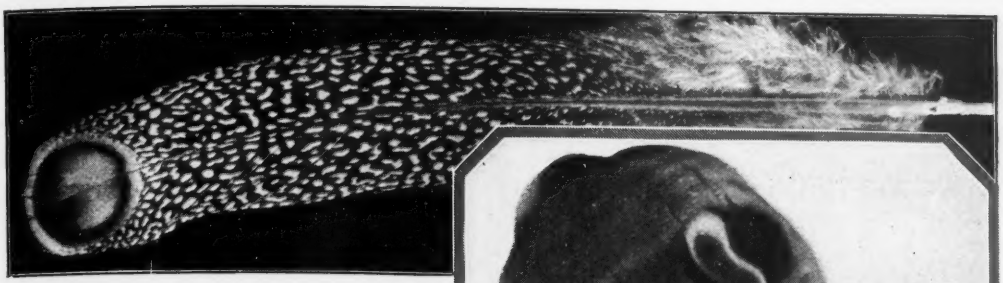
At right: The wonderful auger by which the giant wood-wasp bores its way into tree-stumps



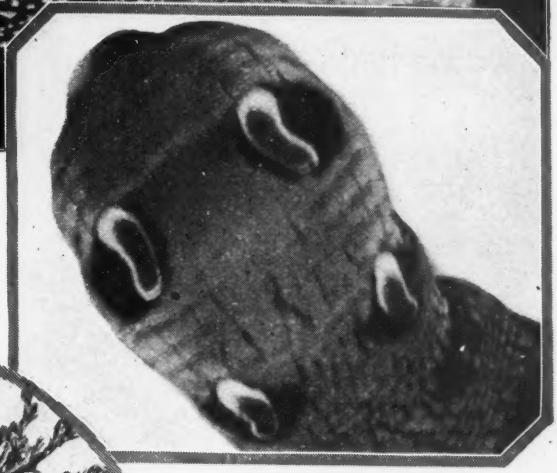
The joints which make up the fore-limb of the male cricket are arranged like scissors and are used for nipping roots

The terminal joint and claws of a beetle might well have been the prototype of the modern grappling irons invented by man

Eyes That Were Never Made for Seeing



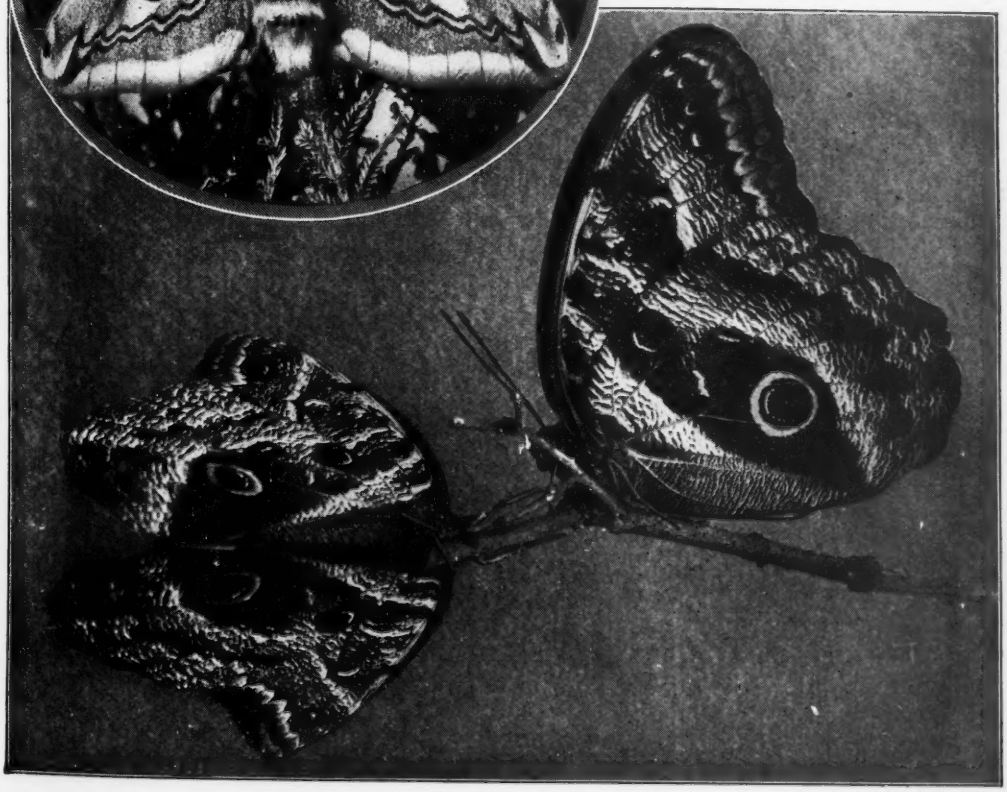
The eye-spots of peacocks' feathers are always admired. This eye belongs to the peacock pheasant of Ceylon



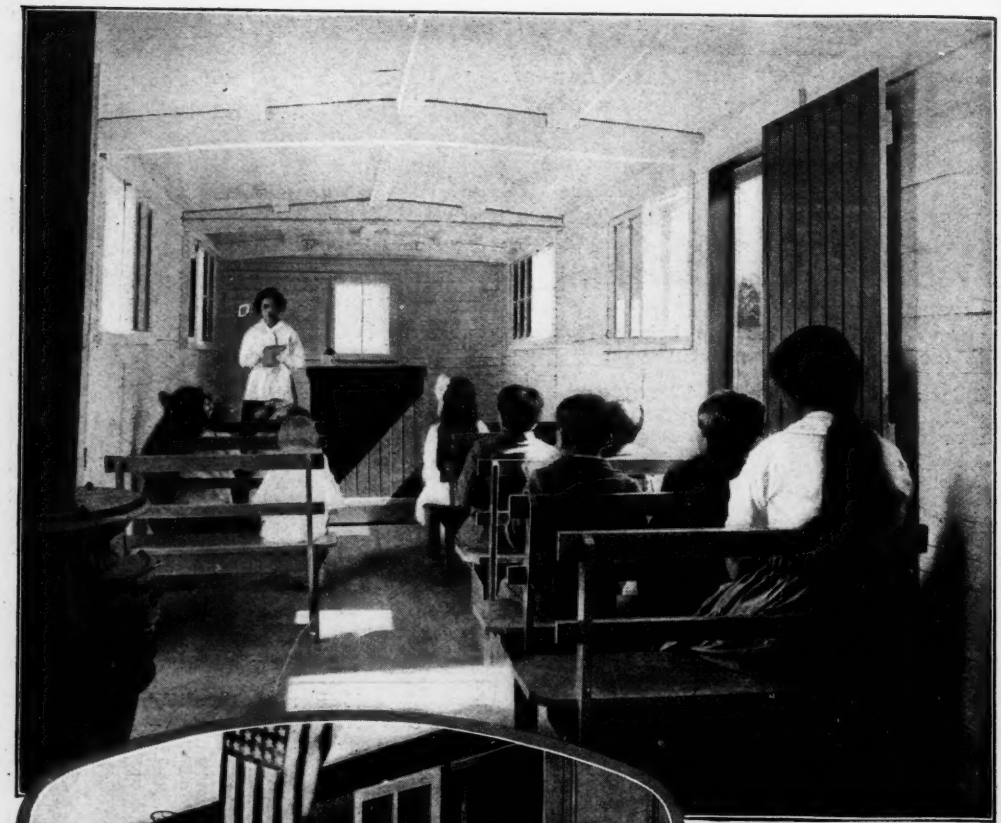
Above: The head of the elephant caterpillar (magnified) showing its "eyes" w ich are not eyes at all

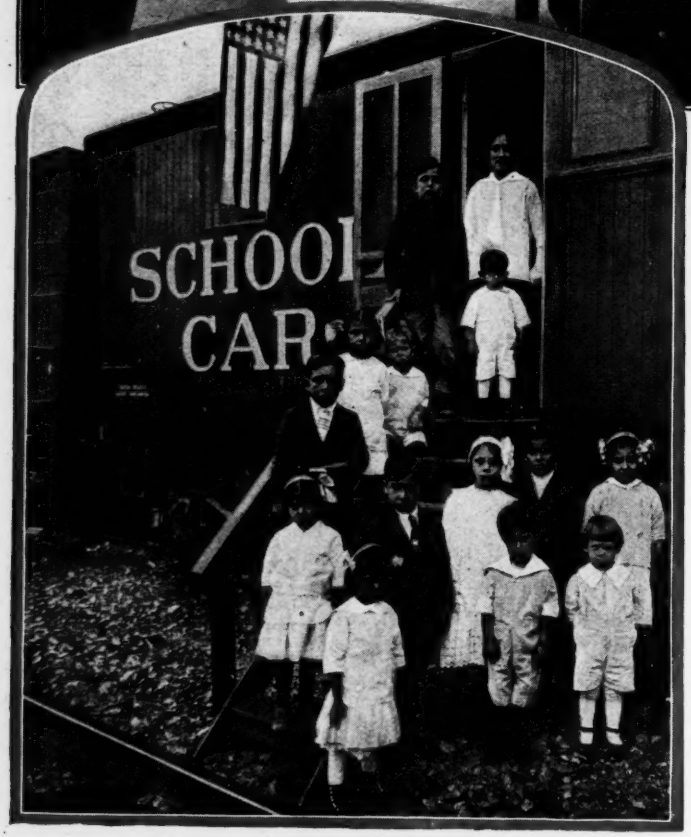
Below: An emperor moth. The eye-spots are terrifying to its enemies, and are a means of "bluffing," it is thought

Below: Two South American Caligo butterflies, called popularly owl butterflies, from their eyes



Going to School in a Freight Car





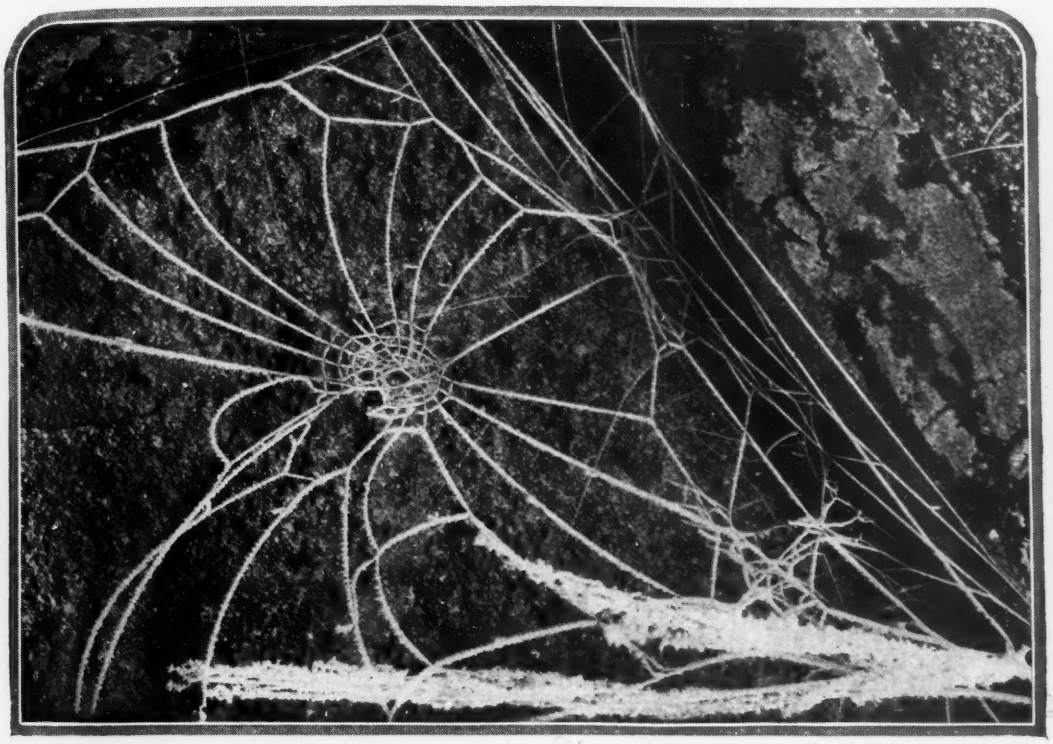
Photos © Int. Film Serv.

The Southern Pacific Railway Company provides a school on wheels for the children of workmen employed in construction work through the west. As the gang moves from place to place their families move with them and the school car with its teacher goes along, so that the children never lose a day of school work

Exterior of the school car and a view of the pupils and teacher. They seem to think it nothing at all to be able to have arithmetic in one town, grammar in another and geography all over the country. School "keeps" however inclement the weather, for they are likely to encounter rain in one town and sunshine in the next

The Wonderworld of Ice Crystals

More than a thousand different forms. You can study many of them at home with a magnifying glass



Apparently this cobweb was first strung with dewdrops, which froze to globules of ice as the air grew colder. This is one form of hoarfrost, but lacks the interest of the crystalline forms

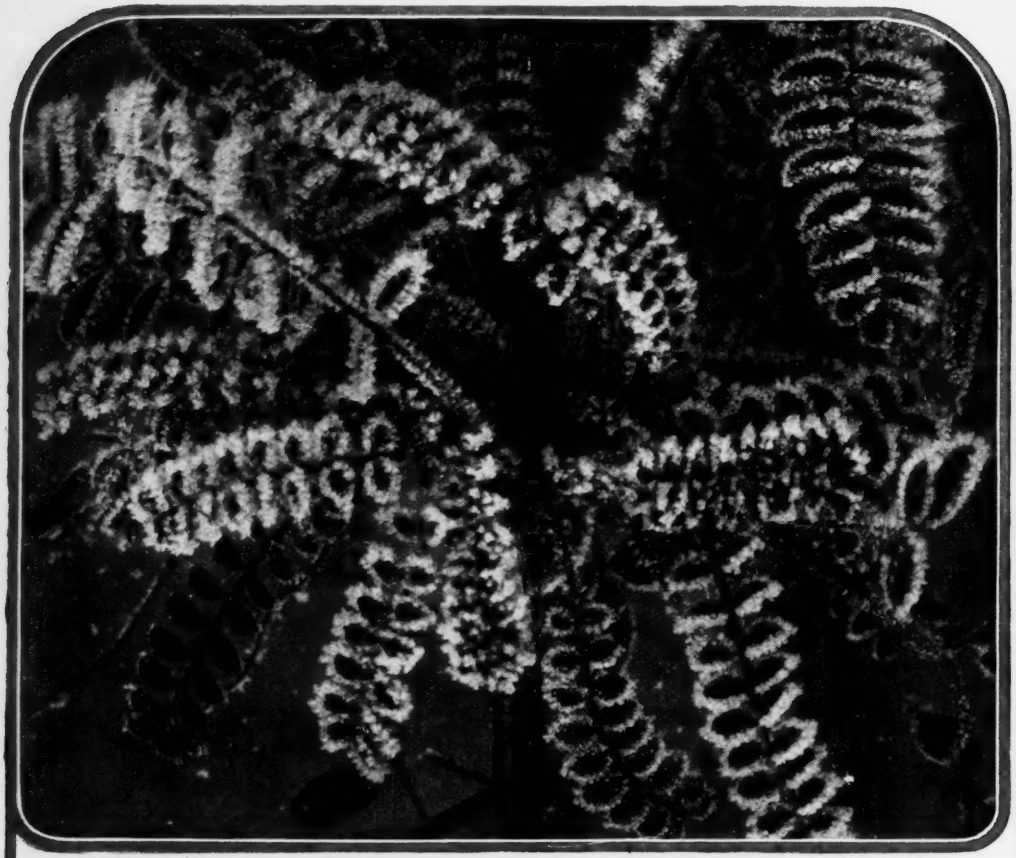
WHEN winter settles down upon the earth, a new artist appears upon the scene. Hardly less varied and not a whit less exquisite than the products of the vegetable kingdom are the flower-like wonders of ice, snow and hoarfrost. If their beauty is not fully appreciated, it is because a close inspection is needed to reveal it. In fact, whoever would feast his eyes on the crystal marvels of the frosty countryside, or of his own windowpane, needs to be provided with a good magnifying glass, or he will miss half the show.

The study of ice crystals has an interesting history, beginning with the works of Albertus Magnus, who gravely informs us that "star-like snow" falls only in February and March. The earliest drawings of snow crystals and also of frostwork on windowpanes were made by the learned Archbishop of Upsala, Olaus Magnus, in the middle of the sixteenth century.

A new era has, however, been introduced in our own time in this class of investigations by the application of photography to the subject. Today more than a thousand different forms of snow and ice crystals may be studied in collections of "microphotographs." One of the facts revealed by the camera is that the perfectly regular forms of these crystals shown in drawings are comparatively uncommon in Nature. When a crystal is originally formed it is, undoubtedly, perfectly symmetrical, but it is so fragile that it is easily mutilated by the wind and by contact with other crystals. In very calm weather, at the beginning of a snowstorm, many single and perfect crystals are wafted gently to earth, and such crystals may also be seen floating in the air in the intense cold of the polar regions, constituting the sparkling ice-haze, known to explorers as "diamond snow," or "diamond dust."

Snow is produced directly from water vapor (i. e., water in a gaseous state) that

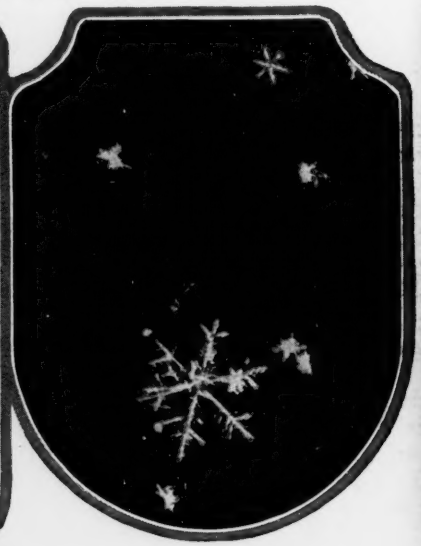
Stars and Flowers of Frost and Snowflakes



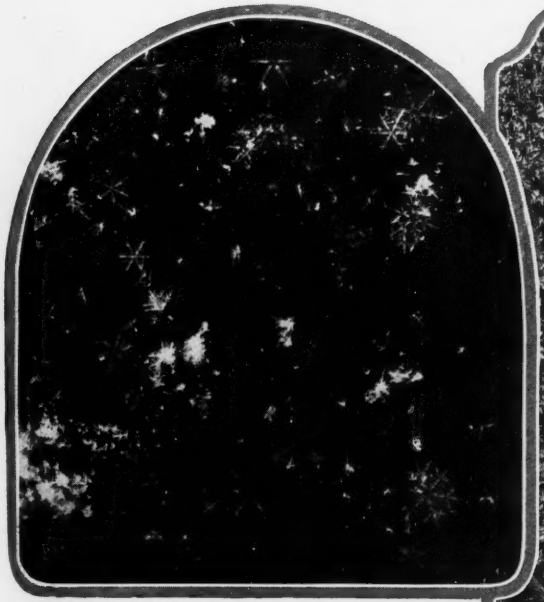
Hoarfrost on leaves. This is sometimes due to the freezing of dewdrops, but more often it is deposited in solid form directly from the air. The crystals assume varied and beautiful forms. Refrigerating plants and breweries yield a wealth of interesting types

Snowflakes magnified. The crystals are wonderfully beautiful but very fragile. Perfect ones are seldom seen except at the beginning of a snowstorm in calm weather

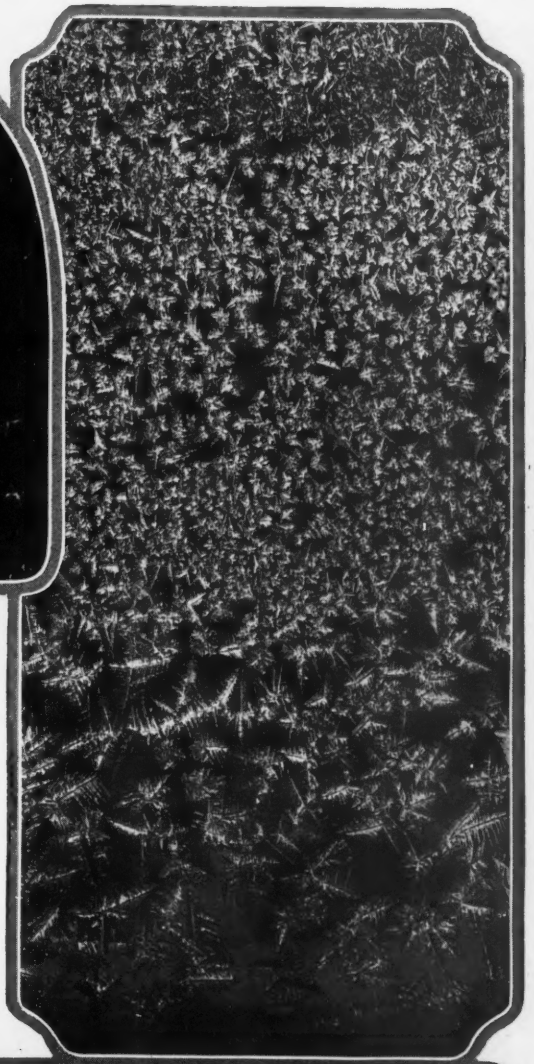
The majority of snow crystals assume the form of six-pointed stars or hexagonal plates, the thickness of which is from a tenth to an eightieth of the diameter



The Wonderland of Ice Crystals

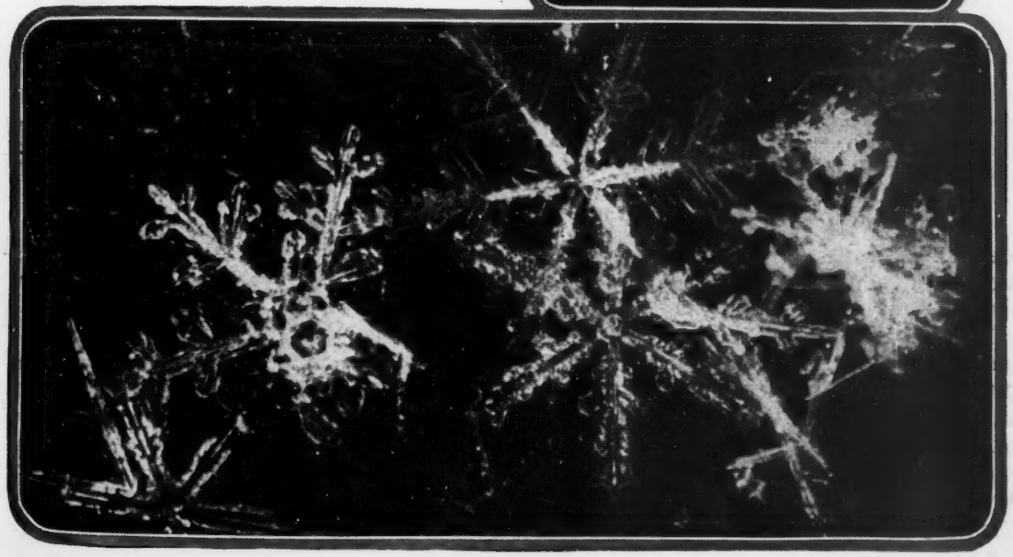


Snowflakes and fragmentary crystals of natural size. The size depends upon the temperature, the largest being formed when the thermometer stands just below the freezing. The star-shaped crystals are the largest



At right: This deposit forms on window-panes in comparatively dry air and in both warm and cool rooms. Alt ough beautiful it is not so striking as the "window ice" which forms indoors in a thin film of water

In the magnified stellar snow crystals below it will be noticed that the branches of the principal rays are parallel to the rays adjacent. The crystals are more or less imperfect but the types are nevertheless distinct

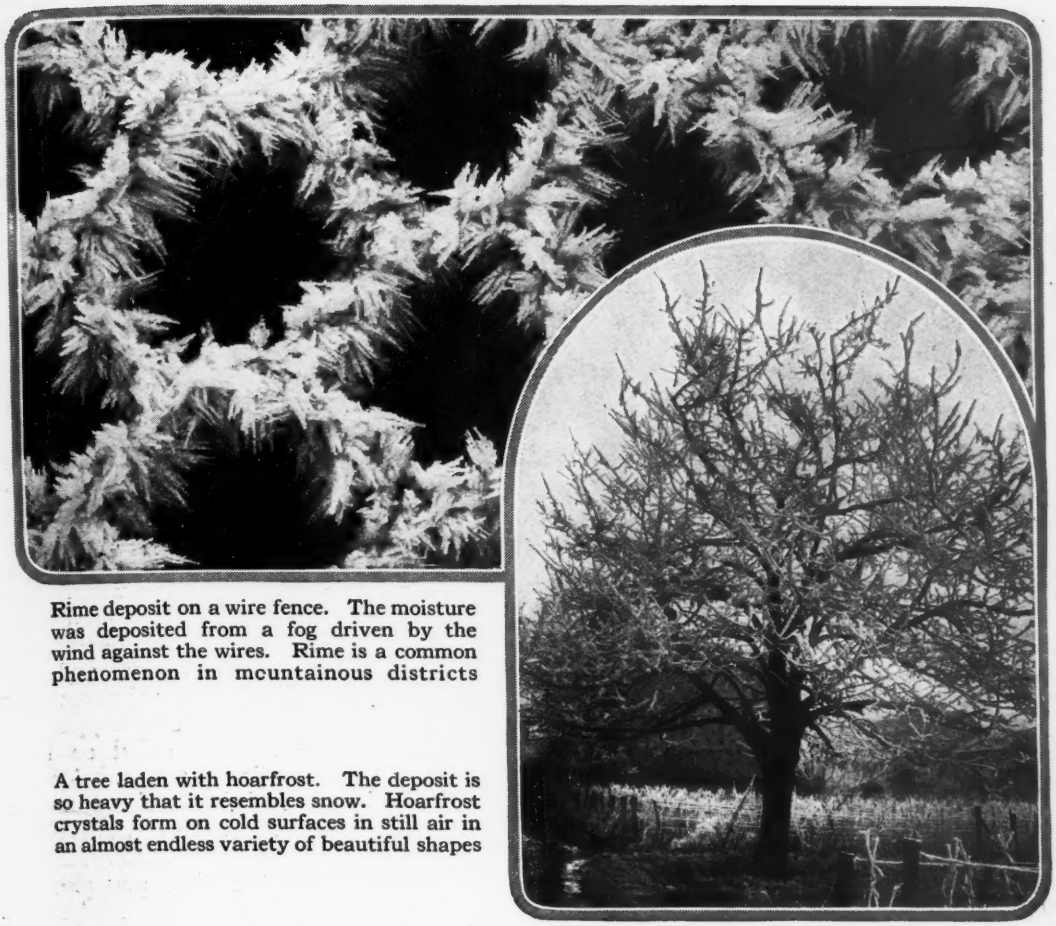


Window ice, natural size. These beautiful deposits assume two principal forms, the feathery and the arborescent. The former is the more common and the more striking in appearance and design. The same pane of glass will exhibit entirely different designs on different nights

exists at all times in the air, and not from raindrops; though, on the other hand, rain is often the final product of snow that melts before it reaches the ground.

The true structure of a mass of ice may, however, be made evident by an experiment that Tyndall was fond of performing in his public lectures. Through a slab of clear ice, revealing no trace of structure, he passed the beam of an electric lamp, the light falling upon a screen. The image of the slab was magnified by a lens. While the light of the lamp was transmitted freely, its heat was partly absorbed by the ice, and produced an interesting transformation. Numerous six-rayed stars and combinations of such stars appeared here and there on the screen. These "ice-flowers," as they are called, resulted from the melting of crystals locked up in the block of ice; they were, in fact, hollow spaces, retaining the form of the original crystals but filled with water.

The invisible moisture of the air produces



Rime deposit on a wire fence. The moisture was deposited from a fog driven by the wind against the wires. Rime is a common phenomenon in mountainous districts

A tree laden with hoarfrost. The deposit is so heavy that it resembles snow. Hoarfrost crystals form on cold surfaces in still air in an almost endless variety of beautiful shapes

not only snowflakes, but also various forms of frost deposit upon terrestrial objects. Hoarfrost is often described as "frozen dew," but it consists less often of frozen dewdrops than of ice crystals deposited directly from the air. It tends to form on horizontal surfaces, cooling rapidly at night by radiation. It may even form on a sheet of ordinary ice, such as the frozen surface of a pond or lake. Beautiful flower-like deposits are produced in this manner.

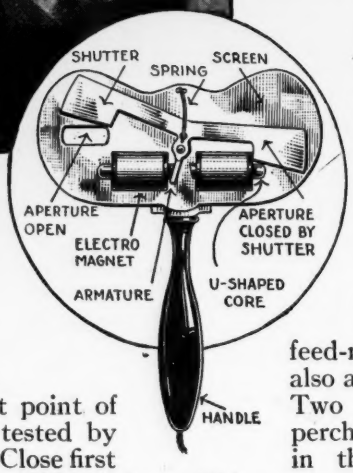
A cold fog will sometimes leave copious deposits of feathery ice crystals on the edges and angles of objects against which the fog is driven by the wind. These often grow to several inches in length, and are best observed on mountains and in the polar regions. Such deposits are now technically called "rime."

The frostwork on windowpanes is sometimes true frost, produced on dry glass, from water vapor in the air; but the beautiful fern-like and feather-like forms are produced in a thin film of water. Many varieties of window-frost and window-ice have been photographed. When the indoor air is very moist, a dew-like deposit of moisture, consisting of minute drops, forms on the glass, and this produces a layer of granular ice, differing from frost crystals.

In spite of their immense variety in detail, all perfect ice crystals have six sides or principal rays. When secondary rays form, they are parallel with the adjacent primary rays. There are two principal forms of ice crystal; viz., the tabular and the columnar. Sometimes the two forms are combined; a column or rod, of hexagonal section, will have at one or both of its ends an hexagonal plate.

Both the size and the shape of snow crystals depend to some extent upon the temperature of the air. The smallest crystals form in the coldest weather. Star-shaped crystals are most abundant when the temperature is not far below the freezing point, while at lower temperatures there is a preponderance of hexagonal plates.

Each spectator carries a viewing disk which has two eye-apertures operating alternately



Giving Body Relief to Motion Pictures

THINGS about us seem solid because each eye sees from a slightly different point of view. This can easily be tested by looking through a window. Close first one eye and then the other, and the window framing crosses the view at entirely different points.

What really happens is that each eye looks "around" rather more of one side of an object than the other eye; and it is the combination of the two impressions on the brain that gives us the final impression of solidity or body.

In a system of projection for motion pictures recently patented by M. F. Sullivan, this principle is applied so as to give an effect of reality or solidity to the film projected on the screen.

By using two films which give the point of view from each eye and projecting pictures from each film strip alternately on the screen, the impression of solidity is attained, since it is only necessary to allow that eye to view the screen when its corresponding film picture is being projected thereon.

Each spectator, however, must carry a viewing disk with two eye-apertures. This is necessary so that the right eye-aperture is automatically closed when the left pictures appear on the screen, and the left eye-aperture is closed when the right pictures are being projected.

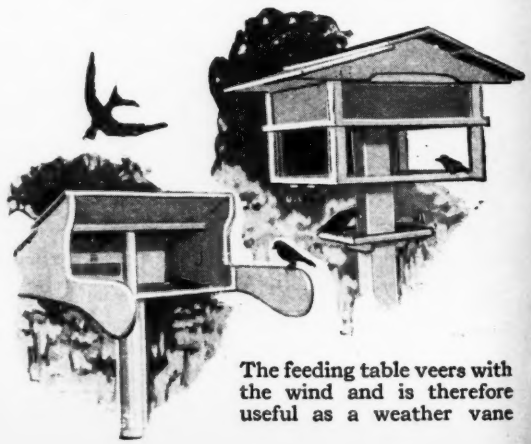
The inventor operates the shutters of the viewing disk electrically to accord with the alternate projection on the screen of the right and left hand films.

A Sheltered Feeding Table for the Birds

BIRD lovers will welcome a new idea in the construction of a bird-feeding table operated on the weather-vane principle. The device is made of white pine with a copper roof and is pivotally mounted on an eight-foot pole, so that it turns with the wind. In this way it is sheltered from storms, and the birds have a dry resting place and dry food, whatever the weather.

An automatic hopper for grain is provided so that there is no waste. A wire feed-rack and hooks for suet are also arranged inside of the shelter. Two arms at the sides furnish perches for the birds and also aid in the swing of the feed-table. This arrangement answers the additional purpose of a weather vane.

The little house illustrated on the right below has a sheltered feeding table underneath it and below that is a still smaller one. The house is commodious and attractive and will furnish housing for a number of birds.

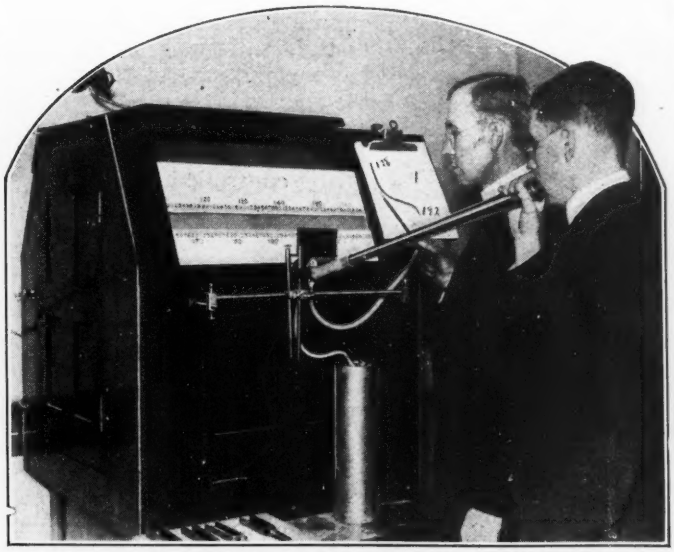


The feeding table veers with the wind and is therefore useful as a weather vane

Seeing the Sounds That You Sing

Clear pictures are made of the vibrations of your voice so that you can detect by sight an error in pitch

IS it difficult for you to sing in tune? Do you distrust your ear? Cheer up! there is hope. You can "find" yourself by your eye. You can stand before an instrument and see in clear pictures every pitch movement of your voice as you are singing; you can see exactly how many vibrations per second your vocal organs are producing, and you can thus tell, at the very moment of singing a note, what error is involved.



The tonoscope in the psychological laboratory of the University of Iowa. It registers the pitch of the tone played or sung

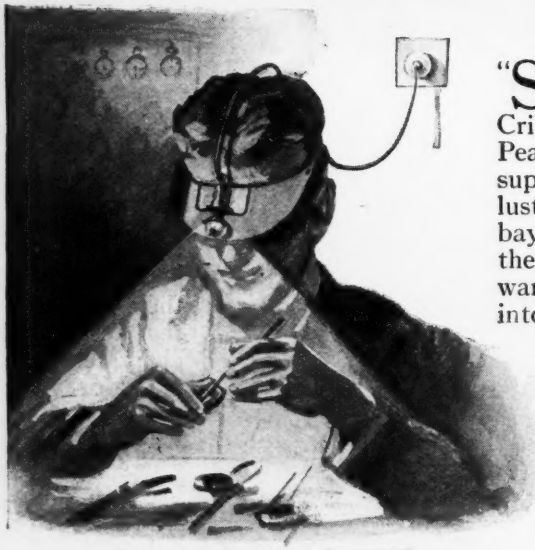
Moreover, the player of the violin, flute, cornet, or other instrument, may treat his instrument in the same way. A person many hundreds of miles away may connect "long distance" with this "musical eye" and project the vibrations of his instrument on the screen. There is, indeed, no limit to which the musician may not go in improving his playing.

The instrument which will do all this is the tonoscope. As yet, there is only one tonoscope available, and that is in the psychological laboratory of the University of Iowa. Professor Carl E. Seashore says: "It furnishes us the first ready and at the same time reliable and accurate means of registering directly the pitch of a tone as sung, spoken, or played with a musical instrument in such form that it can be operated with convenience and safety outside the technical laboratory."

In brief, the instrument works on the principle of motion-pictures. It converts the sound vibrations into pictures on a screen. The screen, which may be seen through the opening in the front of the instrument, has eighty thousand and ninety-five dots so placed that, when acted upon by a sensitive light, they arrange themselves in characteristic figure for every possible pitch within the range of the human voice. Each figure points to a number which indicates the pitch. The dots are arranged into one hundred and ten rows; the first one has one hundred and ten dots, the next one, one hundred and eleven dots, and so on, each successive row having one more dot than the preceding one, up to the last, which has two hundred and nineteen.

When a musician is singing before the instrument and sounds a tone, the row which has the dot frequency that corresponds to the vibration frequency of the tone will stand still, while all other dots move and tend to blur. The row which stands still, therefore, points to a number on the scale which designates the pitch of the tone. In other words, to see the pitch of the tone, one has only to see the number of the line that stands still.

The tonoscope is operated by electric current, which enables it to run indefinitely without disturbance. The speed of the revolving screen is controlled by a tuning-fork with which it must keep step, being driven by a synchronous motor. The instrument indicates the actual pitch of any note to an accuracy of often less than a hundredth of a tone. Even if a note as constant as that of a tuning-fork is sounded, the pitch is recorded accurately in tenths of a vibration, because fractions of vibrations may be read in terms of the number of dots that pass per second.



The eyes are protected from the glare without sacrificing the full illumination

An Electric Light Attachment For Eye-Shades

IN order to bring maximum light upon a piece of work without causing the eyes to suffer from the glare, an electric lamp bulb may be worn attached to an eye-shield, as shown in the accompanying illustration.

Thomas C. Arnold, of Fernandina, Fla., has invented a bracket attachment for the purpose. The bracket is mounted upon a shade or shield of ordinary construction, except that at one end there is a tab carrying a buckle, while at the other end is a strap which buckles snugly around the wearer's head.

The bracket is made from one length of relatively stiff wire, bent in double U-shape for encircling the body of the shade. A clamping yoke is provided to receive the electric lamp bulb, and a guide extension is formed at one end of the wire protruding from the yoke, to receive an electric conductor on the bulb socket. The bracket is detachable and the bulb may be taken out or clamped on easily.

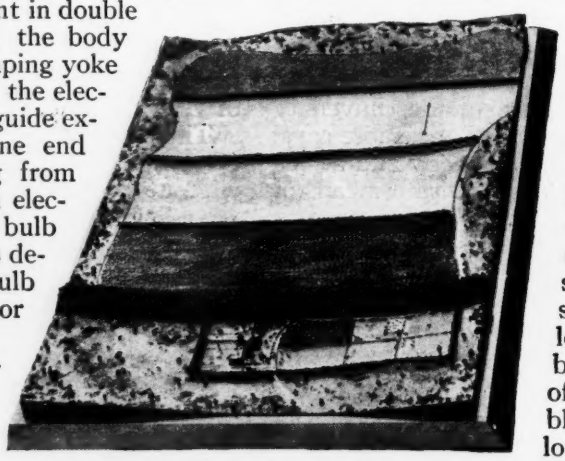
With the bulb arranged in this way the eyes are protected and the light is brought close to the work.

Man Becomes a Beast in Hand-to-Hand Conflict

"SOLDIERS say that they find relief in any muscular action," writes Dr. George W. Crile ("A Mechanistic View of War and Peace," The Macmillan Company), "but the supreme bliss of forgetfulness is in an orgy of lustful, satisfying killing in a hand-to-hand bayonet action, when the grunted breath of the enemy is heard, and his heart's blood flows warm on the hand. This is a fling back into the remote period when man had not controlled fire, had not fashioned weapons; when in mad embrace he tore the flesh with his angry teeth and felt the warm blood flow over his thirsty face. In the hand-to-hand fight the soldier sees neither to the right nor to the left. His eyes are fastened on one man —his man. In this lust-satisfying encounter injuries are not felt, all is exhilaration; injury and death are alike painless. A life-sized photograph giving each detail of the face of a soldier thus transformed in the supreme moment of hand-to-hand combat would give the key to the origin of war."

Tempering the Wind to the Farm by Means of Trees

IF the farmer of today and of the future is not able to squeeze the last pennyworth of value from his land it is not the fault of the Federal Government, for the efforts which are being expended in educating him as to how to do it are never relaxed. Thus, the Bureau of Forestry is conducting a campaign to demonstrate the value of growing trees as windbreaks on the farm, to protect the crops and livestock.



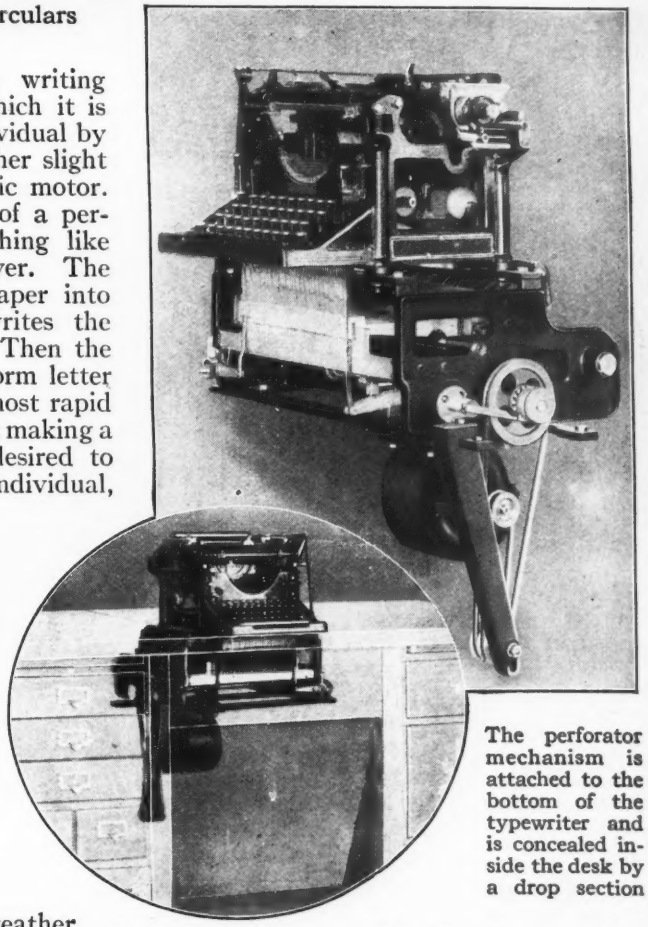
Model of a one hundred and sixty-acre farm showing location of windbreaks

The model shown in the illustration is exhibited at fairs, expositions and farmer organization conventions all over the country. It represents a one hundred and sixty-acre farm and shows the proper location of the windbreaks and the kinds of trees most suitable for the different localities. The trees afford protection from sun and storms.

Giving a Personal Touch to Circulars and Form Letters

A VERY efficient device for writing circulars and form letters which it is desired to make personal and individual by the use of names, phrases, and other slight changes is operated by an electric motor. A record is first made by means of a perforator; this record looks something like the record used on a piano-player. The operator then puts a sheet of paper into the typewriter as usual, and writes the name of the person addressed. Then the perforated record turns out the form letter about five times as fast as the most rapid operator could write it and without making a mistake. If at any point it is desired to make some part of the letter individual, the machine can be automatically stopped at that point so that the operator may write in that portion on the typewriter.

The letters written with this device are in excellent form and cannot be detected from letters written in the usual way. An operator is needed to address envelopes and to fold and insert the letters.



The perforator mechanism is attached to the bottom of the typewriter and is concealed inside the desk by a drop section

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Putting the Bicycle to Work for Twelve Months of a Year

BICYCLES and winter weather do not go well together—unless one converts his bicycle into a bicycle-sled, in order to make it glide smoothly over slippery pavements. This is what A. Tainer, of Montreal, Canada, has done, as is shown in the accompanying photograph.

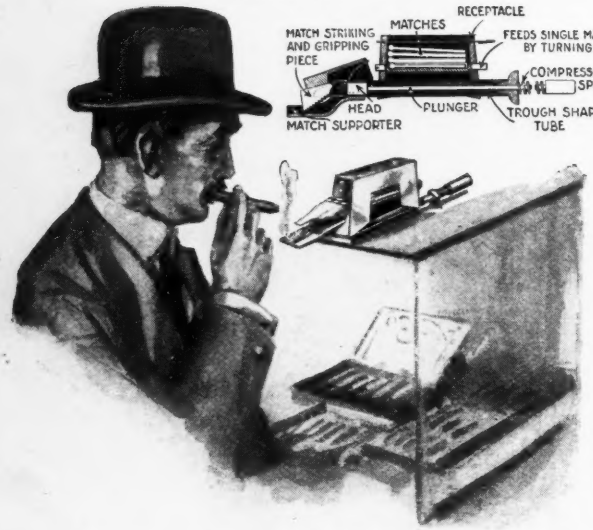
The bicycle can be used both winter and summer. For snow and ice, remove the front wheel and attach a small sled to the forks with steel rods

He removed the front wheel of his bicycle and attached the forks to four steel supporting-rods leading to a small sled. The rods look fragile in the photograph, as indeed they are, but they are none the less serviceable and adaptable for the purpose; for the rider's weight falls on the rear wheel and there is little or no pressure on the sled and its supports.

The bicycle sled is a little more difficult to propel than an ordinary bicycle but it is much easier to ride under the conditions which it is designed to meet, since the sled prevents the rider from losing his balance.

Heavy cord is wound around the rear wheel to give it a grip on the snow and ice. A chain might also be used such as is used on automobile tires. Evidently the originator of this snow-combating bicycle makes considerable speed, for he has a horn attached to the handlebars.

An Obliging Cigar-Lighter Which Feeds Lighted Matches



The match is deposited in a chute and held in position until burned out

IN THE usual type of cigar-lighter found in tobacco shops a constantly burning gas-jet is provided. Instead of this, John A. Cunningham proposes the use of ordinary matches, so arranged that, by pushing a button, not only will a match be fed forward and lighted, but it will be held in place during the interval taken up in lighting the cigar. The economy and freedom from danger are obvious features, for even the remnants of the unused portions of the matches are taken care of in the tray beneath.

Within a chute a number of matches are placed. At the narrowed bottom of the chute a shuttle is provided, for carrying only a single match. When this shuttle is turned it deposits the match into a tube in which is a plunger intended to push the match forward against the head of a movable clip placed at the end of the tube.

The jaw of the clip is arranged with a scratching surface upon which the head of the match can strike as it is pushed forward by the piston.

By the continued forward movement of the piston the match head will not only be struck but will pass beyond the striker till the end of the match is clipped by the jaw against a plate which holds the lighted match in place for the smoker's use, and then drops it into the metal tray provided for the purpose.

A Periscope Attached to Field-Glasses

THE present war of the trenches has stimulated inventive man to devise all sorts of periscopic glasses. The soldier under fire has made periscopes out of any material which happened to be at hand, while skilled opticians in the shops at homes have constructed great super-periscopes out of the best material obtainable.

Several citizens of this country have turned out practical instruments of this kind. One of these is a periscopic field-glass, the invention of Charles F. Smith, of Brooklyn, New York. It can be folded into a compact form when not in use and inclosed in a casing supported by a conventional form of field-glass.

Smith's periscopic mounting consists of lazy-tongs supporting mirrors which are held in inclined position, and which reflect the view ahead to the field-glasses, fixed to a frame at one end. When the periscope is to be used the frame is moved from the casing and the lazy-tongs extended, after which the mirrors at the top of the frame are alined so that the object viewed will be reflected to the person using the glasses. To fold the periscope it is only necessary to disconnect the top mirrors from the frame, whereupon the mirrors fold over thin sheets of felt to protect their surfaces, and the tongs are pressed down until they fit into the space assigned to them in the field-glass casing. The periscope addition does not make it bulky.

The frame is collapsible so that the entire periscope may be concealed within the usual field-glass casing

How I Judge Men

By Harrington Emerson

Illustrated with Photographs Copyrighted by Harris and Ewing

Mr. Emerson is a pioneer in efficiency engineering, an apostle of what has come to be known as "scientific management." Long ago he came to the conclusion that although the best cost-accounting system had been installed in a factory, the best machines bought, the best arrangement of the machines devised, the best method of feeding raw material to the machines worked out, efficiency had not been truly attained unless the right man was given the right job. But how can you tell the right man when you see him? While Mr. Emerson does not attempt to answer the question fully in this article, which he prepared for us, he tells very clearly how humanity may be appraised by well-defined standards.—Editor.

ANY food is better than none. But if there is possibility of choice why not select the best which it is possible to obtain for health and purse?

The difference between the fine, large, perfect apples obtainable everywhere now by the box or piece, and the rusty, shriveled, wormy and rotten apples I used to find in the bushel basket is very great. I like good apples, and not being in a starved condition take no other kind.

How is a good apple created?

By selection.

The prospective apple-grower rejects all stocks except the one he intends to market. He next rejects the entire surface of the globe except the one field he thinks best suited for his orchard, best suited as to climate, soil, exposure, so that the good stock will have best opportunity.

Field Marshal von Hindenburg. Strongly motive; determined and inflexible; very practical, hard and intolerant; great physical strength, power and endurance; a rugged, coarse-skinned man; stubborn; bulldog type; immovable character

The grower cultivates and fertilizes the soil. He favors useful and drives away noxious insects. During growth he may ruthlessly pinch off all undesirable buds, but in any case when the crop is gathered he sorts and selects.

If Cattle Are Carefully Selected, Why Not Men?

How can we expect to secure anything good, a good apple, a good bee, a good dog, a good cow, a good horse, a good man, or a good woman, except from good stock, developed under favorable opportunity and care, and strictly selected as to individuals? I do not expect it. Therefore I apply selection.

Before going any further it is to be noted that the family to which apples, pears, quinces, strawberries, blackberries, and hawthorns belong is the rose family. All these roses are noble and respond rapidly and greatly to opportunity and care.

Unfortunately there are on earth genera as vile as the roses are noble. A Luther Burbank could not develop an ignoble rose, nor could a Mendel elevate a cimex—in plain English, a bedbug.

But there are living creatures in which the good or the bad is not so overwhelmingly in evidence as in the rose or the cimex—species in which it is possible by successive selection to retain the good and breed out the bad. By following the laws of heredity, the thoroughbreds in domestic animals have been established. The racehorse man will enter an unfoaled thoroughbred colt in a future race and bet more money on him than he would dare risk on the most promising-looking and acting colt whose

Mental Type. Quiet and reserved; tolerant; not excitable; close thinker; set, determined views; makes up his mind and draws his own conclusions; more retrospective than observant; slow and deliberate; systematic and self-centered

Mental-motive Type. Strong in self-esteem; energetic; positive and determined; observant; convincing; conservative; good talker; sure of himself and filled with importance of his own work; clear thinker; practical and very energetic

Motive-mental Type. Plausible; agreeable and friendly; anxious to please; energetic and practical; systematic; open-minded; progressive; active and alert; observant; an accomplisher; clear headed; good at outdoor work; great endurance

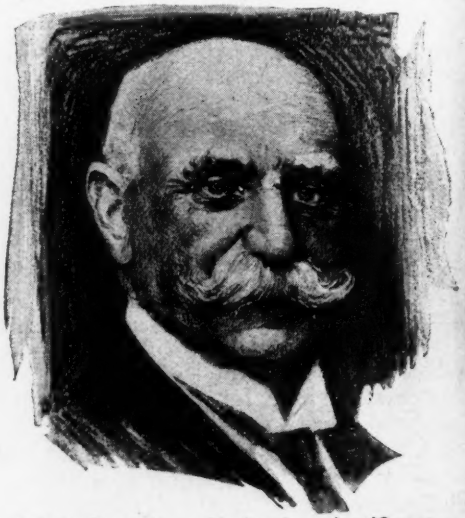
pedigree is unknown. Principles of efficiency were applied to the evolution and development of racers long before they were applied to shopwork.

Horses are not all good as the rose family is, nor all bad as the cimex is. Each horse has in him a great multitude of special characteristics, and, what is quite as important, a lack of other strains, so we can at any time start with a horse in which there is a preponderance of desirable traits and of desirable negatives.

Picking the Right Man Out of 1,600,000,000

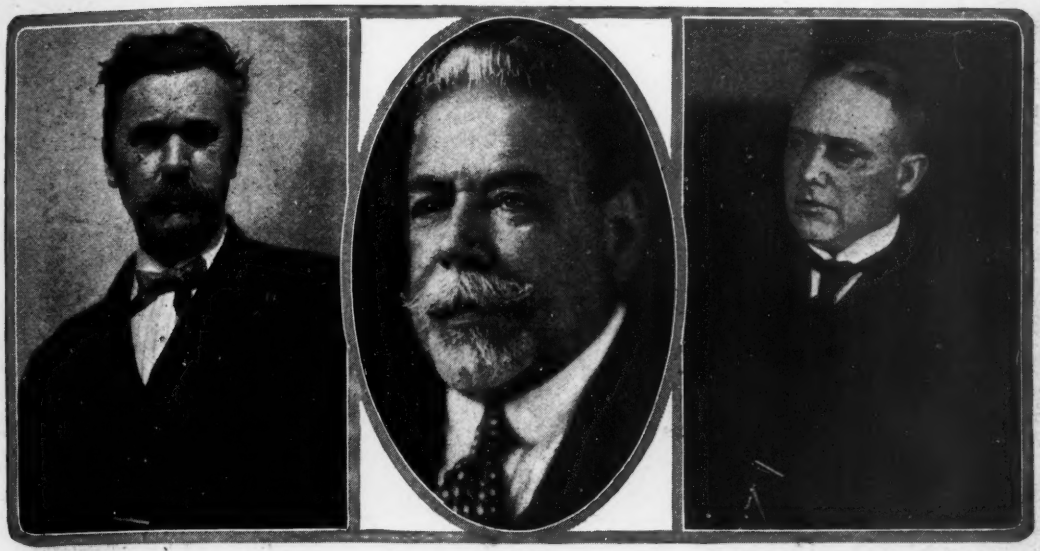
Similarly, in selecting a human being for a position, our aim should be to find as nearly as we can in all the world the man or woman best suited for the position. Not only should the position be well filled, but each worker should be in the highest position he is capable of filling. A Caruso, a Paderewski, a Kreisler, ought not to beg for pennies from door to door.

In my own association of forty men I aim to apply the methods and tests that I recommend to all. I begin at the beginning. When any new work is to be undertaken the first question is this: Should it be done by a machine, an uncarnate thing, or by an incarnate being? It may be far better to assign the work to a windmill, or to a waterwheel, or to some other power engine, than to a man. If, however, we need co-operating, incarnate skill and intelligence, can the work be better done by human or by some other form of life?



Count Zeppelin. Obviously scientific; an investigator; goes into matters with great exactness; has a good mathematical head; works matters out well; great perseverance, resourcefulness; new ideas that are well systematized and worked out. A strong character

If I want to move four hundred pounds



Motive Type. Positive; determined; opinionated; practical; set views and opinions; not easily influenced; stern and severe; impatient; irritable; not fond of society; reliable and inflexible; the rough diamond type of man

Motive-vital Type. Coarse, positive temperament; determined; dogged; opinionated; not a great thinker; self-important; great endurance; strong willed; will put through his schemes in spite of great opposition

Mental-motive Type. Plausible and full of plans; likes to influence others; can conceal his real views and aims in clever talking; positive and opinionated; observant and calculating; plenty of self-esteem; clear-headed

over a mountain trail twenty-five miles a day, it would be better for me to select a mule for the work. If I am going hunting, a suitable dog is better than a man.

Admiral von Tirpitz. A great head for systematizing; a clear planner; arranges and plans beforehand; very little escapes him; good foresight; great will-power and determination; very immobile and hard face; not faltering; wonderful strength of purpose; enormous amount of endurance; hard to influence; thinks for himself; does not want to be told; very broad grasp of possibilities and conception of what is going on about him; has great faith in himself and his conclusions; great force in face—not a weak line; has an eye for the main chance; looks out for himself; not altruistic

Immense losses have been suffered in the past because men were used when wind or water could have been more cheaply harnessed, or men were used when horses and oxen could have done much more. Our ancestors were almost as stupid as we still are. The value of selection between the suitable and the unsuitable was not obvious to them until fifty years ago.

If, however, we have progressed to the point of wanting a man for a man's job, the next question is how to select the right man out of the 1,600,000,000 human beings on earth.

Unfortunate though it may be, many positions are subject to race restrictions, and this in the case of Pullman car positions may cut out all but candidates of African descent, or as to many positions it limits our choice to members of the white race. If it is a government position the restriction is still further limited to American-born or naturalized candidates. We have in this case already cut down our field of choice from 1,600,000,000 to 100,000,000.

The next and more obvious restriction is that of age. The position may be one to preclude those under eighteen years of age or over sixty. This age restriction culls out two-thirds of the hundred million. Most

positions are limited to one sex or the other, and this cuts off another half. We are now down to about 16,000,000. Thus in a few minutes and without expense we have excluded ninety-nine out of a hundred

15. By Physical Soundness
16. By Special or Technical Education
17. By Temperament
18. By Aptitudes
19. By Sympathy
20. By Predominant Type (Vital, Motive or Mental)

Mental-motive Type. Independent; alert and optimistic; observant; self-sufficient; a good speaker; determined and positive; clear in argument; energetic and openminded; progressive; active and energetic; public-spirited man; socially active

Mental Type. Mild and amiable; tolerant but positive; slow and deliberate; clear thinker; not excitable; broad in views; willing to hear both sides of a question; open to conviction; but not swayed by arguments unless convinced of their truth

Mental-motive Type. Clear in views; good talker; decided but reasonable; sincere; likes to find out the truth about any subject; broad in thought; thorough and conscientious; not easily influenced; convincing in argument; above-board

of all the living persons. Real selection has scarcely yet begun.

There is no particular sequence to be observed in applying the exclusion tests. Sometimes one characteristic is more important than another. Age may be more important than sex, nationality may be more important than race, education be more important than natural gift, experience be more important than ability.

The Standard by Which Men Are Judged

In semi-logical sequence:

1. The First Decision Is Between Uncarnate and Incarnate
2. Between Human and Other Life
3. By Sex
4. By Race
5. By Age
6. By Nationality
7. By Eugenics or Heredity
8. By Mental Soundness
9. By Moral Soundness
10. By Industrial Soundness
11. By Early Environment
12. By Training
13. By General Education
14. By Experience
21. By Size (Tall or Short)
22. By Texture (Coarse-grained or Fine-grained)
23. By Coloring (Blonde or Brunette)
24. By Body Build
25. By Shape.

There are other subdivisions, so many in fact that they interest only specialists.

It is evident that most of us in selecting employees pay some attention to the sixteenth requirement—special education. We are apt to overlook the importance of heredity (7), moral soundness (9), industrial soundness (10).

Very few pay any attention to temperament (17), aptitude (18), type (20); undue prominence being given to sympathy (19). Size (21) often is carefully considered, but not texture (22), coloring (23), body build (24), and shape (25). Yet every one of these twenty-five considerations would be applied by any man interested in thoroughbreds, whether pigeons, chickens, horses, or any other domestic animal.

In selecting men who are much less uniform than finely bred animals, it is not so easy in advance to predetermine tempera-

ment and aptitude, or to know instinctively the effect of size, texture, coloring, etc. In the past it often happened to me to be dazzled by a man's mentality or a woman's charm, so that I was totally blind to industrial or moral unfitness. I saved time by acting on impressions; I wasted in the end thousands of dollars.

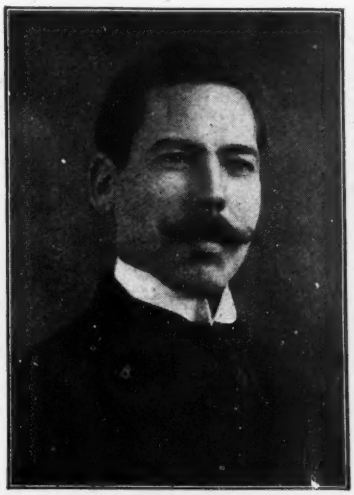
The immense difference in earning power of a good combination of materials, equipment and men, compared with a poor combination is not realized. If the net value produced by a thirty per cent machinist amounts to one hundred dollars a year, the net value of a one-hundred per cent machinist may be between six thousand dollars and seven thousand dollars. If we were certain that the person selected would stay permanently we could well afford a one thousand dollar or even a five thousand dollar-test. But we are not certain. Why? Because we don't know! Because it is easier to take refuge in plausible objections than to exercise care and do some thinking we refuse to select carefully, assuming that it is costly and difficult.

How It Works In Practice

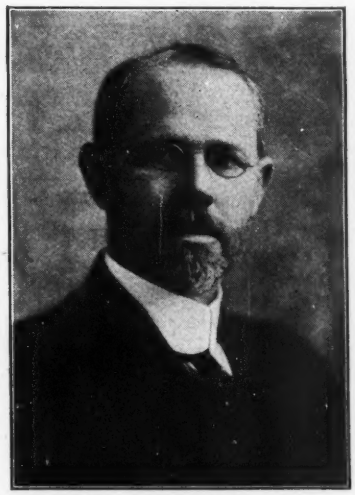
While it is true that it takes a long while to test any man or woman in all respects, the whole life being perhaps not long enough, it is equally certain that a great many tests, weeding out all except the one best in a hundred, can be rapidly and inexpensively applied.

Recently a young man was wanted for a minor technical position on a railroad. The selection was left to me. The following advertisement was inserted in several of the large Metropolitan dailies:

"WANTED: Young man, American, technically educated, of good address for a $60.00 a month position with railroad company. Three months probation then possibility of permanent employment and promotion. Send three post-card photographs, profile, full face, full figure."



Motive-mental Type. Observant; politic; secretive; energetic; alert and active; quick to grasp a situation; good at investigating; critical; inquisitive but tactful; agreeable, plausible manner; practical and systematic; will follow up a subject until it is satisfactorily completed



Mental-motive Type. Systematic; exact and conventional; critical; not easily influenced; conscientious and reliable; not venturesome—must see his way clear; not impulsive; self-restrained; severe but reasonable; just

About three hundred applications were accompanied by photographs. Over two hundred and ninety were rejected in one afternoon on account of some manifest and undesirable quality. Some of them showed by dress, bearing and expression that they were socially and otherwise impossible.

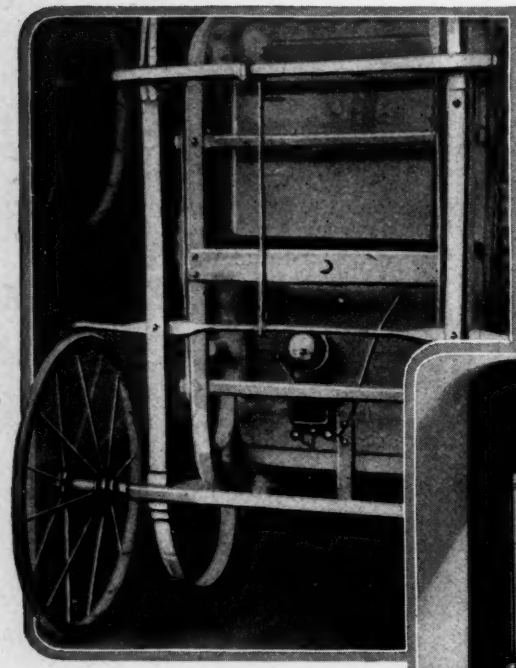
Others were belligerant, obstinate, unteachable, ill-tempered, cynical, self-indulgent, dissipated, deceitful, unreliable. Others were weak. The whole three hundred graded off from a very desirable middle ground of good balance, aptitude and character into extremes of badness in one direction and weakness in the other direction.

The ten picked out as wholly desirable were subjected to further tests. Although we only wanted two we finally took four. They were so good we were unwilling to lose them. Their work has certainly proved that we were not wrong in selecting them.

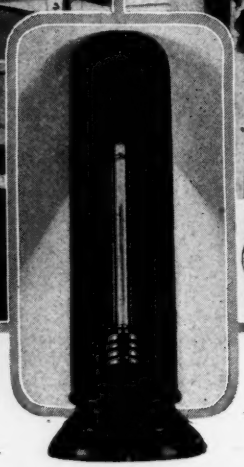
We use the photographic method solely because of its rapidity for a first screening. Personal inspection is very much better but it is not always feasible, as applicants may be scattered over a wide area. Do I attempt to read photographs myself in selecting employees?

I do not any more than I operate the typewriter or the adding machine or keep the books or develop photographs or cook my own food or make my own clothes. I employ specialists.

Housekeeping Made Easy



The up-to-the-minute baby carriage has its electric gong and batteries, operated by a conveniently located push-button, preferably on the handle, to clear the pathway of the carriage

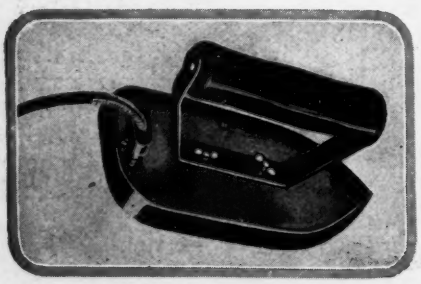


A mahogany thermometer which also serves as a paper weight for the desk

A hinge for interchangeable screen and storm doors. The two parts are interlocking and permanently attached, ball-and-socket style, one to the door frame and the other to the door

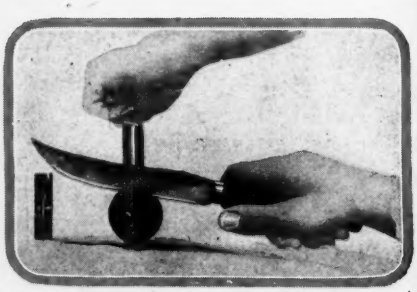
At right: A teaball-spoon with a hinged top which fastens down with a clasp during the process of tea-making. The principal advantage over the ordinary tea-ball lies in the handle

At left below: A combination comb and brush, either part of which may be used separately or both together. The comb, which may be either large or small, locks into a slot in the brush



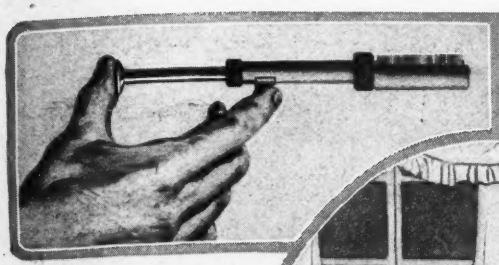
An ironing outfit comprising a nine by twenty-one-inch board weighing one pound and a lightweight electric iron and cord, for travelers and light housekeeping

An egg-beater, of heavy glass with a plunger having two separated dashers

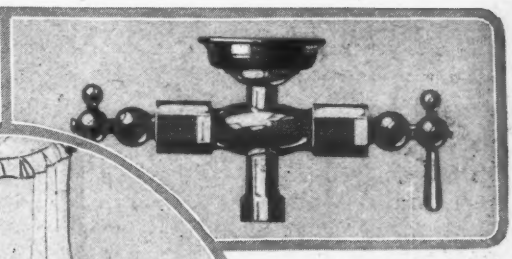


Two saucer-shaped sharpening stones pivoted between U-shaped arms of a handle, for sharpening knives without the least danger of cutting the hands

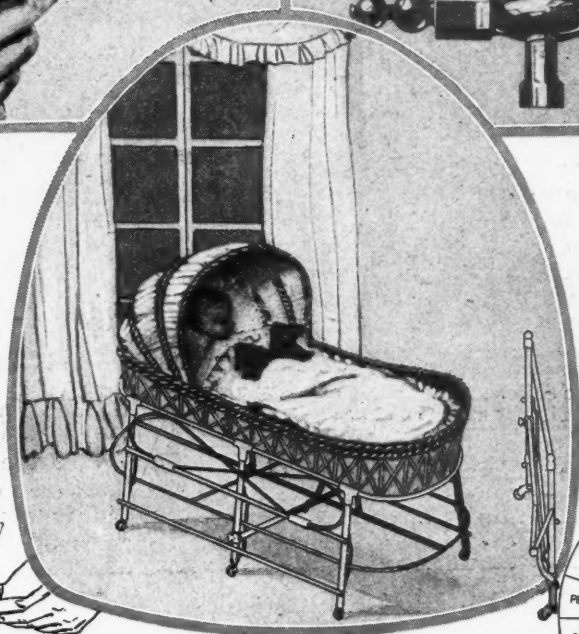
Housekeeping Made Easy



A new type of toothbrush which has the approved rotary motion. It operates back and forth, also, by means of a plunger rod which is controlled by the finger and thumb, so that it may be made to reach all parts of the mouth

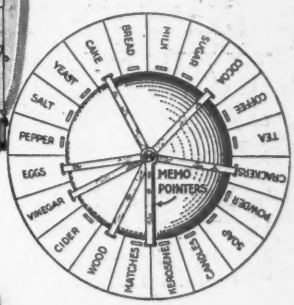


A metal soap dish that will hold soap of almost any shape. It may be fastened to the ordinary faucet soap dish with solder or a small machine screw. It is commodious in size and the soap cannot slip off



A collapsible supporting frame for a bassinet. It is unusually strong and may be folded up compactly and stored away

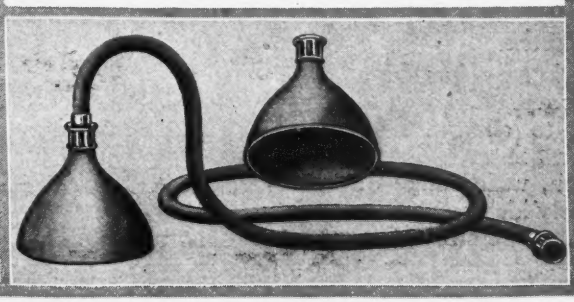
Above: The most convenient strainer we have seen yet. It fastens over the rim of any size pot or saucepan



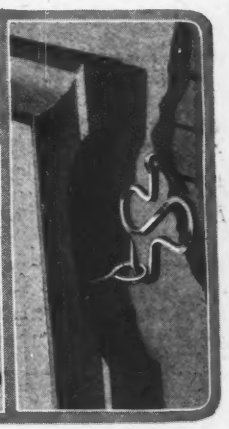
Above: A kitchen reminder plate. In the center is a pin from which pointers are led to the labeled sections

The hood fitted over the burner at the right drives the flame inward, conserving the heat and saving one fourth of the gas consumed by the burner on the left

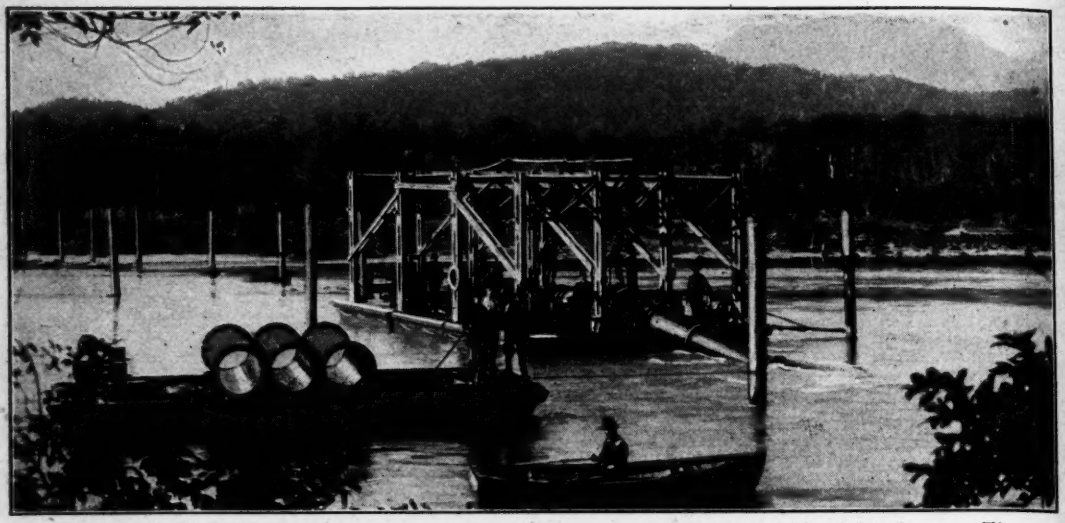
A leather strap serves as a coin purse and also as an umbrella holder



A suction cup attached to the garden hose, utilizes the pressure of the water system to clean drains. The force is constant and the work is accomplished in about thirty seconds



This set of picture hooks does away with wires for hanging pictures



In spite of a five mile current, one hundred and fifty tons of pipe were laid in eighty hours. The work was carried on without mishap and has held against severe floods and record-breaking tides

Laying Pipes in a Treacherous New Zealand River

WITH equipment hastily constructed to meet the difficulties of the occasion, a company of engineers laid pipe-lines across one of the swiftest of New Zealand streams, the Teremakau River. This pipe-line is an extension of the Government water-race to supply the Kumura gold fields. The sections of pipe were laid from specially constructed pontoons, one being joined to the other as the pontoon progressed. The work was carried on without mishaps in spite of a five-mile current. Altogether one hundred and fifty tons of pipe were laid in eighty hours.

Since the pipe crossing has been installed, the river has experienced a number of severe floods. On one occasion its width increased from six hundred and fifty feet, which is normal, to nearly three thousand feet.

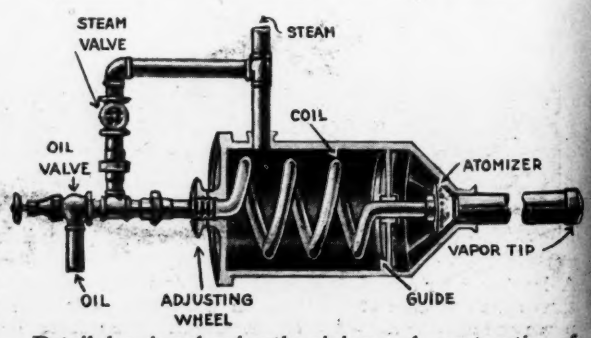
A Fuel-Oil Burner Which Provides Ideal Combustion

A NEW fuel-oil burner has been designed by Grover C. Long, of Lakeland, Florida, to eliminate all free oil from the furnace and to give continuous operation, wide range of capacity and as nearly ideal vaporization and combustion as possible.

In the illustration the metal body contains a coil and a pipe which conveys the steam-oil gas to the furnace. The adjusting wheel is used for varying the capacity of the coil, and the coil is heated by the steam entering at the top of the body and passing around the coil. A guide maintains the coil centrally in the body. A head on the coil has slots through which the oil enters the body after being heated. A valve controls the oil supply, and also allows live steam to pass through the coil for cleaning purposes.

Fuel-oil is admitted into the coil through the oil valve, the coil being heated to a high temperature by the steam admitted at the top of the burner. The oil, in passing through the coil, is heated to a point at or above the flash and is ejected through a series of holes in the head, where it combines with the steam that flows in a different plane at a high velocity, atomizing and vaporizing the hot oil from the coil.

The vapor thus formed then flows at a reduced velocity along the conveying pipe and finally emerges into the furnace through the tip at the right of the illustration.



Detail drawing showing the piping and construction of the fuel oil burner to be used in connection with furnaces

Prince, the Only Ice-Skating Bear in the World

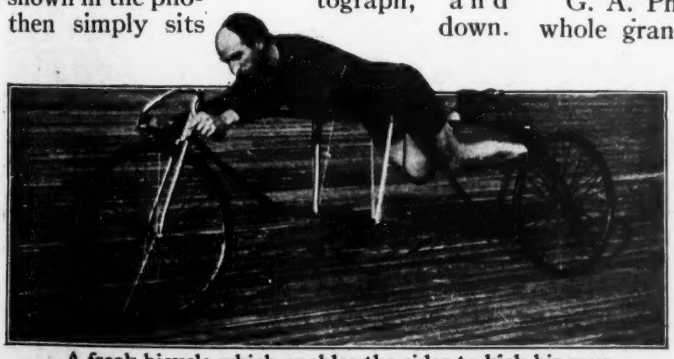
PRINCE, the Skating Bear, is not a left-over from last year's skating craze. He skated in his native Russia long before society ever heard of the "figure eight" and the "flying Dutchman." To be exact, Prince has been skating for the past five years, most of that time on roller-skates. He came to New York this winter to show the skating multitudes how a Russian brown bear can skate gracefully—and fall down gracefully, too. That is something no human can do.

In the "Who's Who Among Bears" Prince is listed as the only ice-skating bear in the world. He wears a number seven shoe, laced in front, if you please. His skates are double-runners and are securely fastened to the shoes. When Prince skates he straightens up on his hind legs and then strikes off in a leisurely manner, increasing his speed as he progresses. His owners have to watch him carefully to see that he does not overheat himself.

© Am. Press Assn.

Prince wears a number seven regulation ice-skating shoe attached to double-runner skates

But by far the most remarkable thing about Prince is his faculty of "feeling a fall coming on," according to his owners. When Prince feels himself about to hit the ice or the ice to hit him he bends his back in about the same position in which he is shown in the photograph, and then simply sits down.



A freak bicycle which enables the rider to kick his way along. He kicked a half mile in less than a minute

A Maternity Hospital's Method of Identifying Infants

A MODIFICATION of the Bertillon system has been adopted by a Chicago maternity hospital for identifying its tiny charges. Before the infant is an hour old a footprint record is taken, the usual mode of procedure being to smear the little foot with printers' ink and press it against a sheet of white paper. The ink is then removed from the foot with absorbent cotton saturated with alcohol or benzine. In another and cleaner method recently adopted for the same purpose, cold cream is employed instead of printers' ink. The impression is made in grease on the white paper and sprinkled with powdered charcoal to bring it out clearly. The record is then filed away in an envelope with the other data of the case.

Riding a Bicycle on Your Stomach—One Way of Getting There

WHY ride a bicycle the usual way when you can lie down on it and kick yourself along just as you kick the covers off the bed each morning? After you ride a dozen miles or more your stomach may get sore, but that shouldn't bother you. Just think how foolish you are making all the other bicycle riders look?

G. A. Phillips, of Chicago, Ill., made a whole grandstand full of spectators look enviously at him when he demonstrated to them at the Newark, N. J., Velodrome how easy it was to sprawl over his built-to-order bicycle and wheel himself around the track.

He covered a half mile unpaced in fifty-nine and two-fifths seconds, which isn't so bad when you take into consideration all the comfort he enjoyed during his travel.

The Modern Scientific Detective

By A. D. Montgomery

The following article is published with the cooperation of the New York Police Department. Inspector Faurot, well known throughout the country as the head of one of the ablest detective bureaus in the country, staged the crime which is illustrated in the accompanying photographs. The pictures have been made with the sole idea of illustrating the scientific methods which are now employed by Inspector Faurot and his men in bringing a criminal to book.—EDITOR.

THE last person who had seen the mining engineer alive was the cleaning woman. She had left him in his office at 5.30 o'clock in the evening. The office force had gone home, and he had remained to finish up some work. In the morning he was found bowed down over his desk—stabbed to death. Evidently he had been dead for many hours, and the murderer had had ample time to effect his escape. There must have been a brief struggle. Apparently he had tried to summon assistance by telephone before he was killed.

When Inspector Faurot appeared on the scene, the first step was to photograph the room from every angle. Why? Because the relative positions of clues might prove of importance, and these positions might be disturbed by a careless rummaging around. Then began a minute examination of the room. Not a square inch was overlooked—not a scratch, not a stain.

A few days later Inspector Faurot summoned one of his men.

"Look for a man who has consumption, who has dark hair and who owns a blue serge suit," said the Inspector.

Two enemies of the murdered man were arrested. One of them had been associated with him in mining work and the other had incurred his displeasure by requesting him to make a false report. One of the two had a cough. His sputum was examined and found to be full of tuberculosis germs. Unable to prove an alibi, he broke down and confessed.

It is perfectly apparent that science played some part in this tracking of a criminal. But how?

Like all modern detectives, Inspector Faurot calls in chemists to help him. He uses their special knowledge as he would a tool. He brought with him to the scene

The first thing the police do on reaching the scene of a murder is to photograph the room before anything is touched. The photograph above shows where a particularly baffling murder was committed. The murdered man fell forward with his head on the desk. Had it not been for the pool of blood on the floor, the overturned chair and the fallen telephone it might seem that he had simply fallen asleep over his work. The crime was committed after business hours and was not discovered until the next day so that the murderer had time to escape. Yet he was arrested

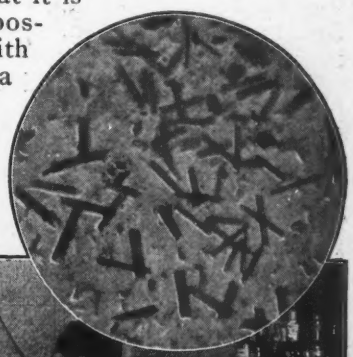
The murderer spat upon the floor. The detectives discovered it and are taking a sample of the sputum for examination in the laboratory

Dr. Klein and Dr. Pascini of New York's Central Testing Laboratory—a seven-story building filled with the latest scientific paraphernalia, equipped to test anything from steel girders to fly-specks. No weapons or clues were to be found. A bundle of papers held together by a leather strap had been opened, but whether by the mining engineer or his murderer, could not be determined. The end of the strap had been broken off. The piece was missing. Following the instructions of Inspector Faurot, the chemists took that piece of strap into their possession.

Inspector Faurot discovers what may be a trace of blood on the door-knob

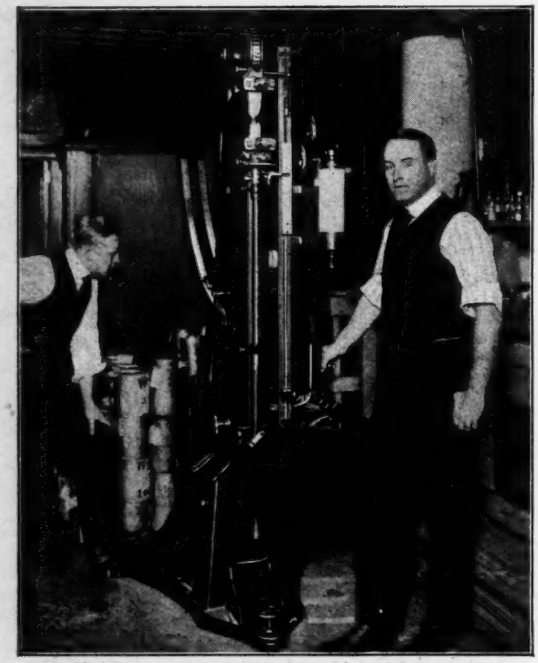
The inspector observed that someone had spat upon the floor. The two chemists took a sample of this sputum. The inspector further observed that there was what appeared to be a blood-stain on the door-knob. He examined this for finger-prints. There was none, because the murderer had so moved his hand that a clear finger-print was not obtainable. Nevertheless, the door-knob was removed and taken to the laboratory.

Once in the laboratory with the evidence thus collected, the chemists began their work. Under the microscope, tubercle bacilli were immediately identified. At once the search was narrowed down to a man who had consumption, who spat freely and who probably coughed. Next, the stain found on the door-knob was tested. Was it or was it not human blood? A delicate test was made with a rabbit which had been injected with human serum. The serum obtained from a rabbit thus treated is a sensitive reagent which at once reveals the presence of human blood in a solution. The chemists found that the stain on the door-knob was indeed that of human blood. But of what human being? Another test was made for malarial parasitic and other organisms. So delicate are blood tests that it is sometimes possible to state with certainty that a given sample of blood has been taken



At right: A photograph of the blood as it appeared under the microscope

Above: Inspector Faurot holding the door-knob while Dr. Klein tests the blood print. Dr. Pascini is examining under the microscope scrapings from the victim's finger-nails. The rabbit will be used in the blood tests. At left: The central hair was found in the nail-scrapings



Testing two pieces of strap, one found at the scene of the murder, the other in a suspect's pocket

from an anaemic person. Often the field is narrowed down to one or two persons.

The chemists examined the scrapings from the murdered man's finger-nails. Under the microscope they found shreds of human hair and fine particles of blue cloth. The murdered man had worn a suit of dark gray. There was no trace of blue dye in it. Evidently, the cloth must have been torn from the coat of the murderer.

With the chemists' report before him, Inspector Faurot narrowed the search down to the mining engineer's two enemies. And the chemical and microscopic clues furnished by the Central Testing Laboratory enabled him at once to charge the tubercular suspect with the crime.

But what of the strap? How did that figure in the case? Was it the same as the piece found in the suspect's coat pocket? To answer the question, comparative tests were carried out in the Central Testing Laboratory. Both pieces were stretched until they broke. Thus their tensile strength was determined. The readings of the machine were identical for both pieces.

When the suspect confessed, he said that he had opened the bundle of papers hoping to find an old mining report which he could use to make a favorable report on his mine. He had intended to forge the murdered man's signature.

A Pneumatic Device for Destroying Devastating Animals

IT has been estimated by the Government that ten million dollars' worth of crops are annually destroyed by ground squirrels in the United States. Besides, these animals are said to transmit such diseases as the Bubonic plague. To make war upon them, therefore, an unusually handy and effective device has been invented by Irving D. Charlton and Professor W. T. Shaw, of the Department of Zoology, State College of Washington. It consists of a circular container which is filled with some poisonous liquid such as carbon bisulphide. A handle is geared to a suction fan in the device. As it is turned the fan causes a current of air to enter the opening formed by the inner wall of the circular container. The air current strikes against a perforated disk which is mounted on the fan-shaft and which rotates with it. The air is then deflected and flows towards the outer rim of the disk, some of it going through the perforations into the liquid in the container and some of it going through the wetted perforations nearer the top of the device. The air then proceeds along towards the fan, carrying some vaporized liquid with it. On reaching the fan the mixture of vaporized liquid and air is forced by the fan down the discharge pipe.

The gas is forced through the pipe into the burrow and the animals therein are asphyxiated

A Fireless Locomotive

It is run on live steam secured from the power plant on the factory site and stored in the engine tank until gradually exhausted

THE locomotive illustrated consists of a large, round-ended tank with a false end at the front and fitted with only such apparatus as is required for the control of the steam to the cylinders. The latter, all the driving mechanism and the outside lagging to prevent heat radiation are exactly like those of an ordinary locomotive.

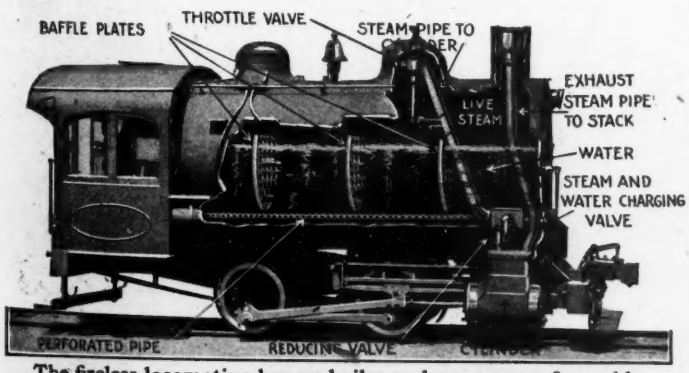
Three crosswise perforated baffle plates are fitted in the tank. These serve to prevent the water from surging from one end to the other and to prevent the locomotive from rocking.

In operation, the tank is first filled about half full of water. This enters through a valve at the front and passes into and out of a long perforated pipe extending the full length of the tank near the bottom. Then live steam from the power plant on the factory site is admitted to the tank through the same pipe as was the water. By the time the pressure between the boiler and the tank is equalized, generally at one hundred and fifty pounds, the water level in the tank will be raised considerably and the temperature of the water will be nearly equal to that of the steam by which it is charged, about three hundred and seventy degrees Fahrenheit.

For freight-car switching service in and around industrial plants and factories, the fireless locomotive meets an urgent need

The steam is then drawn off through a throttle-valve in a dome in the tank top and led through a pipe to a reducing-valve in the false front end of the tank. This valve reduces the pressure of the steam to between sixty and sixty-five pounds per square inch before it is led to the cylinders. These are especially large in diameter so that the piston area is such that the locomotive can be moved when the steam is at a pressure of four pounds. The exhaust steam is carried out through a pipe in the stack as shown.

As the steam is used, the pressure in the tank becomes less and less, allowing the water to evaporate gradually and maintain a steam supply until it has been depleted to the point where it is no longer sufficiently effective.



The fireless locomotive has no boiler and no means of providing fire. Outwardly, however, it resembles the steam engine

Invading the Lofty Precincts of the Bald Eagle with a Camera

IN pictures all babies look alike, whether they are princes of the blood or mere editors' infants. The accompanying illustration, for instance, might easily pass for a newly hatched chick in the nest of an old pet hen. It tells nothing of the giant ragged cliffs overhanging the Rio Grande River, on the summit of one of which the nest was made by a great kingly bald eagle which could easily gouge out the eyes or tear open the scalp of the daring photographers. The picture was made by men in the employ of the Reclamation Service. Needless to say, the mother bird was not present to pose her baby before the camera.

Such intimate glimpses of an eagle's nest are as scarce as the proverbial hens' teeth

Is a Hero Judged by the Number of His Scars? Just Look at the Car Below

THE dispatch-carriers of an army are its nerves, transmitting messages from all branches to the head. When telephone and telegraph systems are demoralized automobiles are pressed into service.

The accompanying illustration shows a bullet-riddled French army automobile that carried three dispatch-carriers across a dangerous zone on the Somme fighting front. German bullets pierced it through and through, ripping the tires off the rims, tearing the engine-hood from its moorings, cutting through both sides of the car, and mushrooming against its internal parts but the car reached its destination with its mechanism intact and practically uninjured.

© Underwood and Underwood, N. Y.

Although the car was riddled by bullets it carried its three occupants to their destination. The chauffeur was severely wounded but he stuck to the wheel

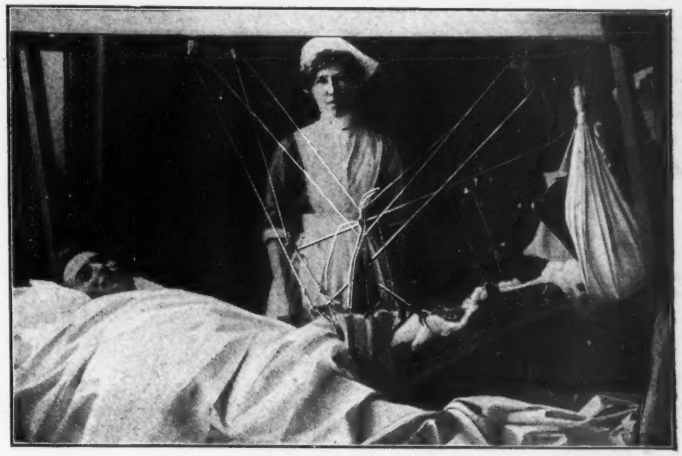
Saving the Shattered Legs of the Fighting Man

EVEN amidst the horrors of this present war the soldier of today is better off than ever before. At his beck and call are the foremost surgeons of Europe and the most up-to-date hospital equipment in the world. Never was there a war in which the injured fighter was given such expert treatment.

One of the most important tasks devolving upon the surgeon is to prevent soldiers with shattered legs from becoming cripples for life. The accompanying illustration shows an apparatus employed to save a soldier's leg severely injured by a shell. Such an apparatus was used in our Civil War with great success. Dr. Fred H. Albee, who recently returned to this country from the American Ambulance Hospital at Neuilly-sur-Seine, France, where the photograph illustrated was taken, counted one hundred and ten soldiers with their shattered legs in slings.

The apparatus consists of weights, pulleys and rubber bandages to support the leg in a position where the open wound will heal quickly and where the bones will knit together without causing the leg to be too short or too long. From time to time X-Ray pictures are taken to see that the bones are growing together properly.

Where a simple fracture of the bone has taken place the leg is placed in a cast, but when the flesh has been ripped and the bone badly shattered a special scaffold has to be erected over the patient's bed and pulleys and weights utilized to enable the bones to grow together in their correct positions. Sometimes it is necessary to exert great pressure to prevent the bones from shortening.



By means of weights and pulleys and spring devices the leg is exercised judiciously and prevented from shortening

It Must Be Great to Be a Boy in a "Santa Claus" Town

AMONG the children it has been generally reported for ages that the headquarters of the jolly patron saint of Christmas is somewhere in the vicinity of the North Pole. But this theory has been exploded both by Peary and Dr. Cook, so that even the tiniest youngsters now discredit it. Germany has been recognized as a great distributing center, if not the actual abode of the saint; but anyone will realize that the condition of affairs in Europe just now are not congenial to a saint.

However, we have it on good authority that Winchendon, Mass., is now the favored spot. There the principal occupation of the grown-up residents is the manufacture of toys, and there the after-school hours of the children are spent in the neighborhood of the factories, on the lookout for a chance at trying-out some of the sample articles, as in the photograph on the left.

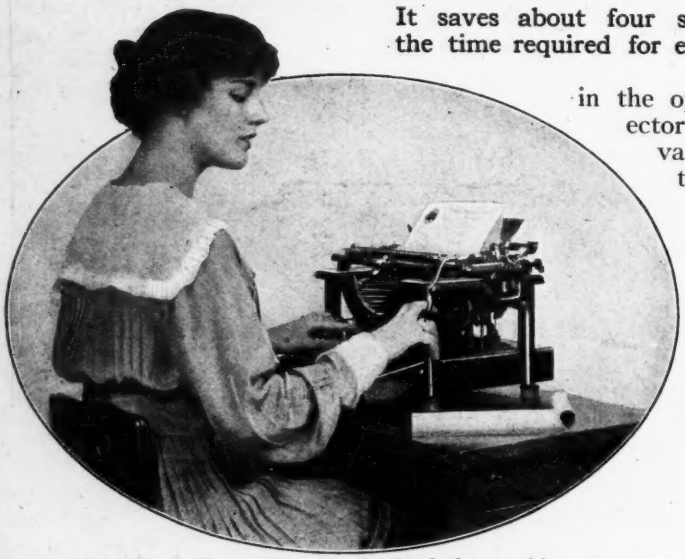
So many of these great toy factories are now running full blast, that Winchendon has gained the name of the Toy Town of the whole United States.

© Int. Film Serv.

A scene around one of the many toy factories at Winchendon, Mass., the toy town of America

This Typewriter Is a Self-Starter

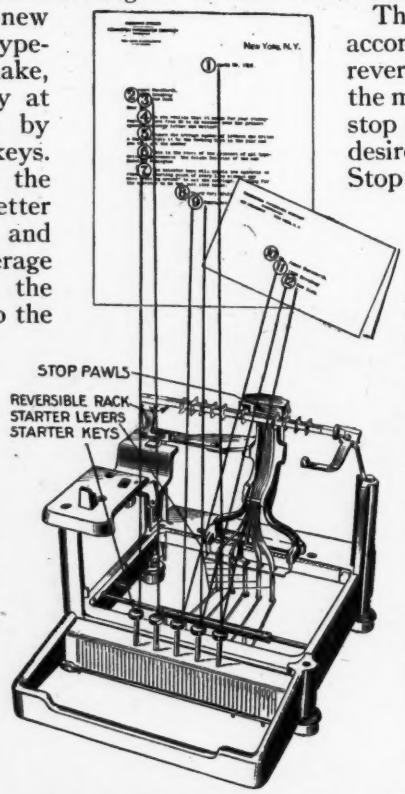
It saves about four seconds of the time required for each letter



After the indicators on the back of the machine are set the typist is relieved of the necessity for any mental computation in the operation of the machine

ELIMINATING the hand settings of a typewriter carriage for the writing of indented lines, the new self-starting device fitted on typewriters of one prominent make, starts the carriage instantly at the correct starting point by simply pressing one of five keys. When it is realized that the writing of the average letter requires twelve dead stops and that each stop means an average time loss of four seconds, the yearly saving attributable to the device will be appreciated.

The self-starter is an improvement on the old column selector previously used on some typewriters in that after the indicators on the back of the machine are set, each of the self-starter keys indicates the same starting point irrespective of the position of the carriage on the line. This relieves the operator of the necessity of any mental computation in the operation of the keys, which from the mechanical standpoint, was one of the most serious drawbacks in the operation of the old-style selector mechanism. Another advantage of the self-starter is that the mechanism operates from either end of the line. If the carriage has passed the starting point of the next line of writing it is not necessary to return to the beginning of the line and then jump forward to reach the proper point. It can be jumped back instantly to the starting point desired. The importance of this advantage can be understood by noting the starting points of the indented lines of the average letter. In most cases it will be found that the termination of the last writing line is beyond the starting point of the next indented line.



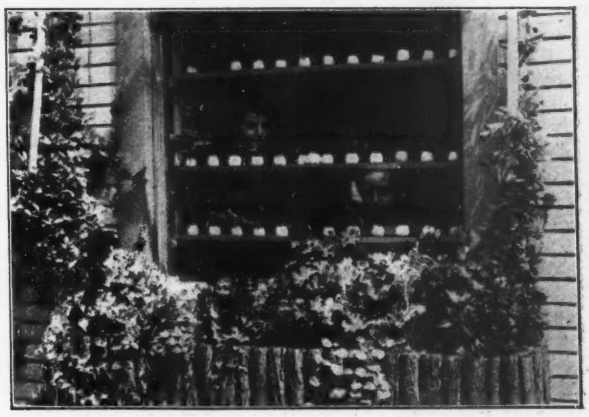
Pawls operated from the self-starter keys contact the stops

The operation of the device is accomplished by the use of a reversible rack on the back of the machine. Different shaped stop pieces can be set at any desired positions on the rack. Stop pawls operated from the self-starter keys by levers come into contact with the stops according to the shapes of the latter which are so designed that the movement of, say, the third key permits the first two stops to be jumped. This enables the carriage to be moved immediately to any desired stop, no matter whether it is to the right or left of the stop.

The device will be appreciated most especially by the typists, who will realize more vividly than others the meaning of a few seconds saved from the time required for the writing of each letter or the spacing of each tabulated statement.

Reforming Bad Boys with Egg-Shells. Distracted Parents Please Note

IT was Christopher Columbus who first advertised the possibility of standing an egg on end; but it remained for the residents of a suburb of Dayton, Ohio, to profit by the ability to utilize the shell in its stationary position. The method employed is similar to that used by Columbus, except that the contents of the egg-shell may first be eaten or used for other purposes; afterward the shell is wiped off and the large end is carefully chipped so that the shell stands securely. The profit comes in utilizing the shell for starting a window garden.



The egg-shells take the place of the first tiny clay pots and are later set into the ground

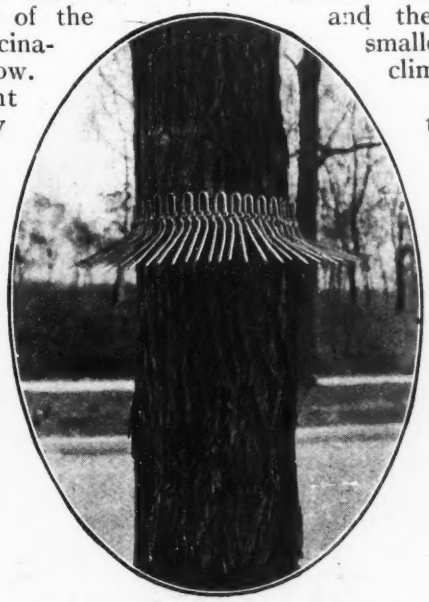
The idea was first conceived at a settlement house in the suburb mentioned, in an effort to interest and reform the bad boys of the neighborhood. The little plants were started in the dainty egg-shell cases, and, being given plenty of fresh air, sunshine and water, they grew first in the sunny windows of the settlement house and afterwards in the homes of the children, whose interest was aroused and held by the novelty of the idea as well as by the fascination of watching things grow. In this way the settlement workers obtained not only companionship of the children but also an entrée into their homes.

The egg-shells take the place of the first little pots in which the seeds are planted. But as the plants grow to suitable size for transplanting, they are placed, shells and all, directly into holes made for them in the ground. The shells hold the water and dirt so long as they are not in the ground, but they soon crack or rot off after being planted, and the roots of the plants grow on undisturbed. This is a decided advantage over the ordinary method of potting, and results in a quicker growth than would be possible with clay pots, from which the roots would have to be transplanted at least once and usually twice.

Preventing Cats and Squirrels from Climbing Trees

AN effective guard to prevent cats and squirrels from climbing trees to destroy birds has been put on the market by a western manufacturer.

It is nothing more than a wire net with protruding points which expand with the growth of the tree trunk. The guard can be fitted to large and small trees, and there is no animal of the smaller class agile enough to climb over it.



Only a very acrobatic cat or squirrel could climb over this tree-guard

Several years ago when the western part of Colorado was overrun with jackrabbits the farmers were at a loss to know what to do to prevent their trees and haystacks from being destroyed. The rabbits attacked everything edible in sight, including trees and even thorny bushes.

Of course, the farmers could not protect their haystacks but they did devise a means to save their trees. They bought all the scrap tin they could and fashioned it into guards similar in design to the one illustrated. These were securely nailed to the trees. It wasn't long before the rabbits passed on to a more hospitable section of the country. In the spring, rolls of cotton saturated with a vermicide are placed over the top of the wires to keep caterpillars away.

With the ever-ready motorcycle, hills are not necessary adjuncts to bob-sledding. This machine develops between sixteen and twenty horsepower and is capable of hauling a hundred men

The Motorcycle Becomes Popular for Sledding Parties

THE horses on the Adirondack and Swiss lakes, who earn their oats during the winter months by pulling long bob-sleds of pleasure seekers over the ice, stand a fair chance of resigning in favor of the motorcycle.

The illustration shows thirteen men enjoying a ride on the power exerted by one motorcycle. If there were forty men on the bob-sled instead of eleven the motorcycle wouldn't say a thing but would speed along possibly at increased rate to show its capability. The machine develops between sixteen and twenty horsepower, and through the reduced gear could pull as many as a hundred men with comparative ease. A chain on the rear wheel is the only concession which is made to the ice.

There is one record of where a motorcycle pulled a five-ton truck with sixty-two full-grown and healthy Americans aboard. Of course this record was not made on ice.

Turning a Motorcycle Into a Motor Ice-Sled

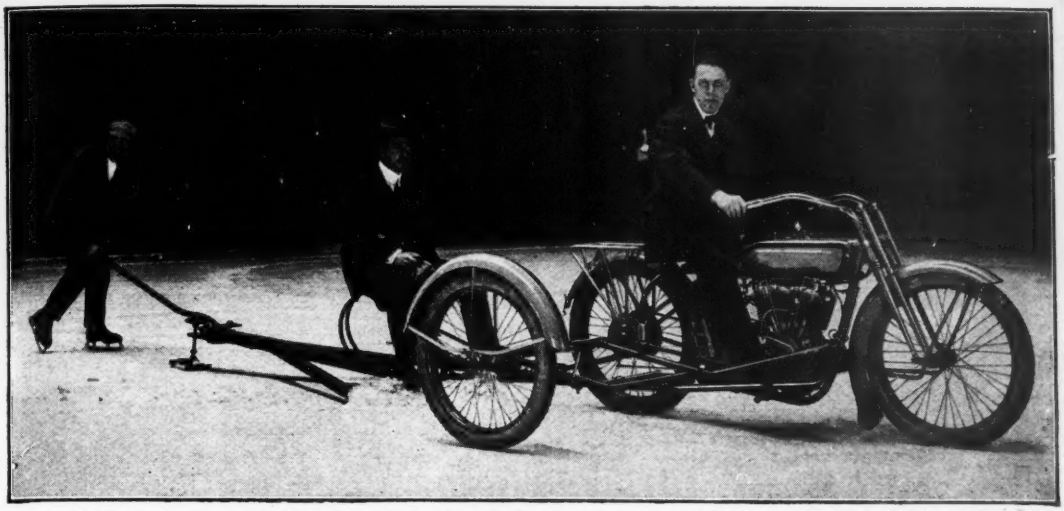
WITH the frozen Hudson River stretching away in the distance like a broad ribbon of smooth glass, Michael Cimorelli couldn't resist the temptation to make a motor ice-boat out of the motorcycle that was standing idle in the garage.

Accordingly, he took his machine apart and by using the engine, rear wheel and accessories made an ice-boat which covered a mile and seven-eighths in two minutes.

Part of the frame of the motorcycle was anchored in the fore part of the ice-boat and the rear wheel was carried in the forks to propel the boat. Tire chains gave traction over the ice and the rear rudder, steered from the wheel, guided the boat. The gasoline tank was placed in the extreme rear behind the driver's seat as shown in the illustration below.

The boat is capable of speeding over the ice in record time, or of navigating the city streets during weather suitable for sleighing.

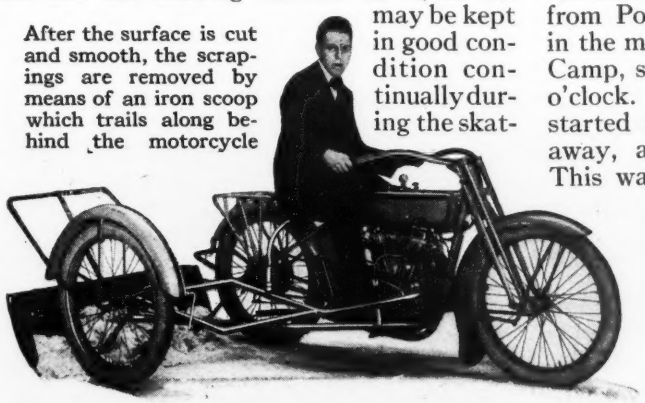
Part of the frame of the motorcycle is anchored in the fore part of the ice-boat and the rear wheel is carried in the forks to propel the boat. The gasoline tank is in the rear



With the motorcycle ice plow the surface is first cut away one-eighth of an inch with a steel blade. The rear tire is fitted with short, sharp spikes. The inventor is astride the cycle

Smoothing Skating Surfaces With a Motorcycle Ice Plow

THE motorcycle plow is not, as the name may seem to indicate, a new solution of the motor tractor question. It is an entirely new creation—a scraper and a planer for cleaning away the ridges caused by sharp skates on ice rinks. By its use the skating surface on thick ice may be kept in good condition continually during the skating season. The motorcycle is especially geared for this task, so that it runs slowly and smoothly when in use, making not more than from three to four miles an hour.



After the surface is cut and smooth, the scrapings are removed by means of an iron scoop which trails along behind the motorcycle

The rough ice surface is first scraped clean and smooth by a knife-blade, which cuts away about one-eighth of an inch; then the scrapings are removed by a scoop. The rear tire is fitted with short, sharp spikes, so that the motorcycle has a firm grip on the slippery surface. The extra wheel on the scraper gives a sure balance.

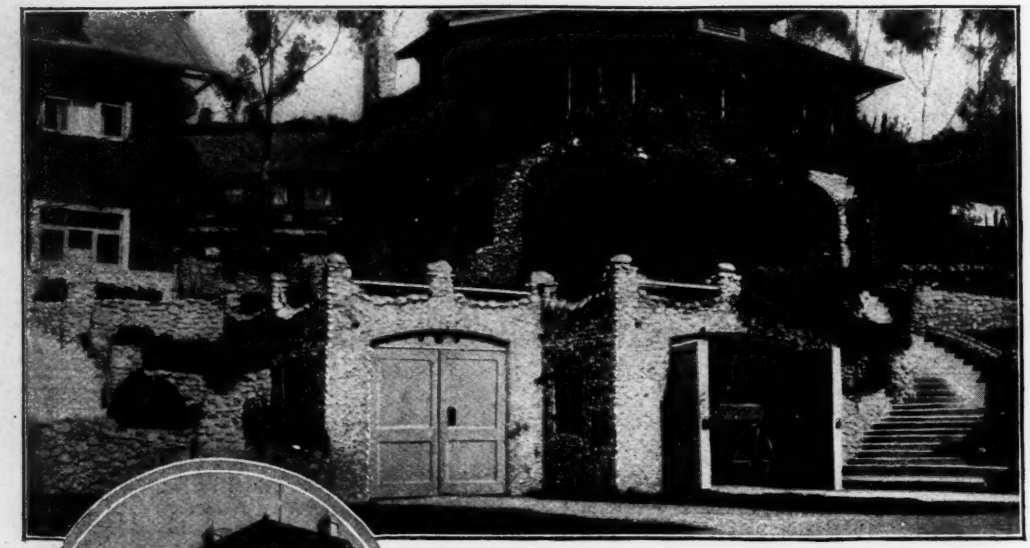
Making a New Motorcycle Altitude Record on Mt. Hood

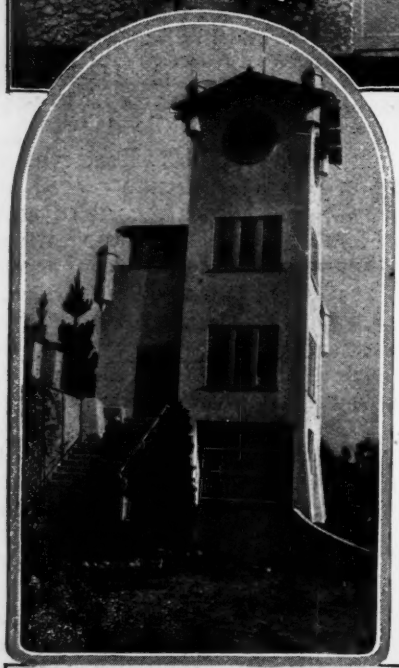
IN attempting to climb Mt. Hood recently a new motorcycle altitude record was established. The former record of seven thousand feet, made in 1914, was bettered by two thousand feet by a trio of motorcycle enthusiasts who braved wind, storm, ice and snow. The record-holders started from Portland, Oregon, before six o'clock in the morning and arrived at Government Camp, situated sixty miles away, at seven o'clock. After resting for a few hours they started for Emergency Camp, four miles away, at two o'clock in the afternoon. This was one of the most trying ordeals ever experienced by motorcycle riders, the entire four miles of roadway consisting of rocks and boulders. However, the riders reached Emergency Camp in good condition.

After an overnight rest the climb was continued from Emergency Camp at five o'clock the following morning. For hours the three riders fought with steep grades and deep snow until the final goal of nine thousand feet was reached at nine o'clock. At this point the machines were obliged to run over a thick, hard crust of snow, and in some places the weight was too great for the snow, causing machine and driver to stop abruptly. Several times the crust was only a thin sheet, so that the riders had to walk along with their machines.

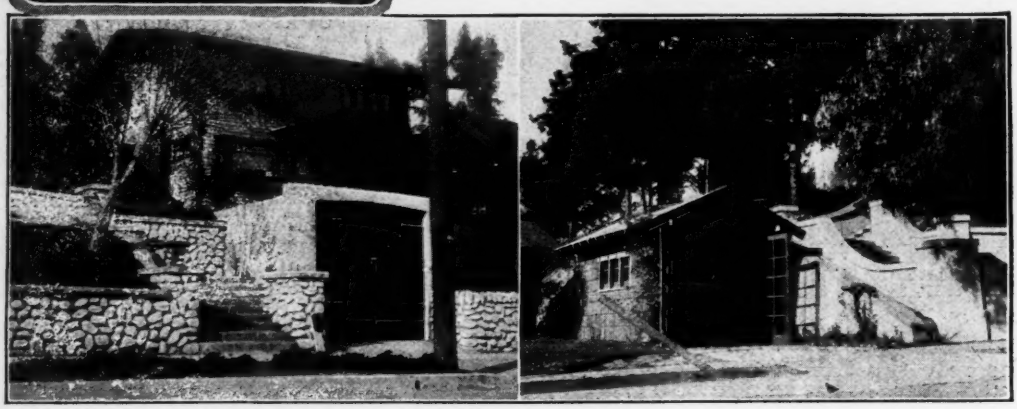
The return trip to Government Camp was made under still more trying circumstances, for the sun had melted the snow.

Combining the Garage with the Home

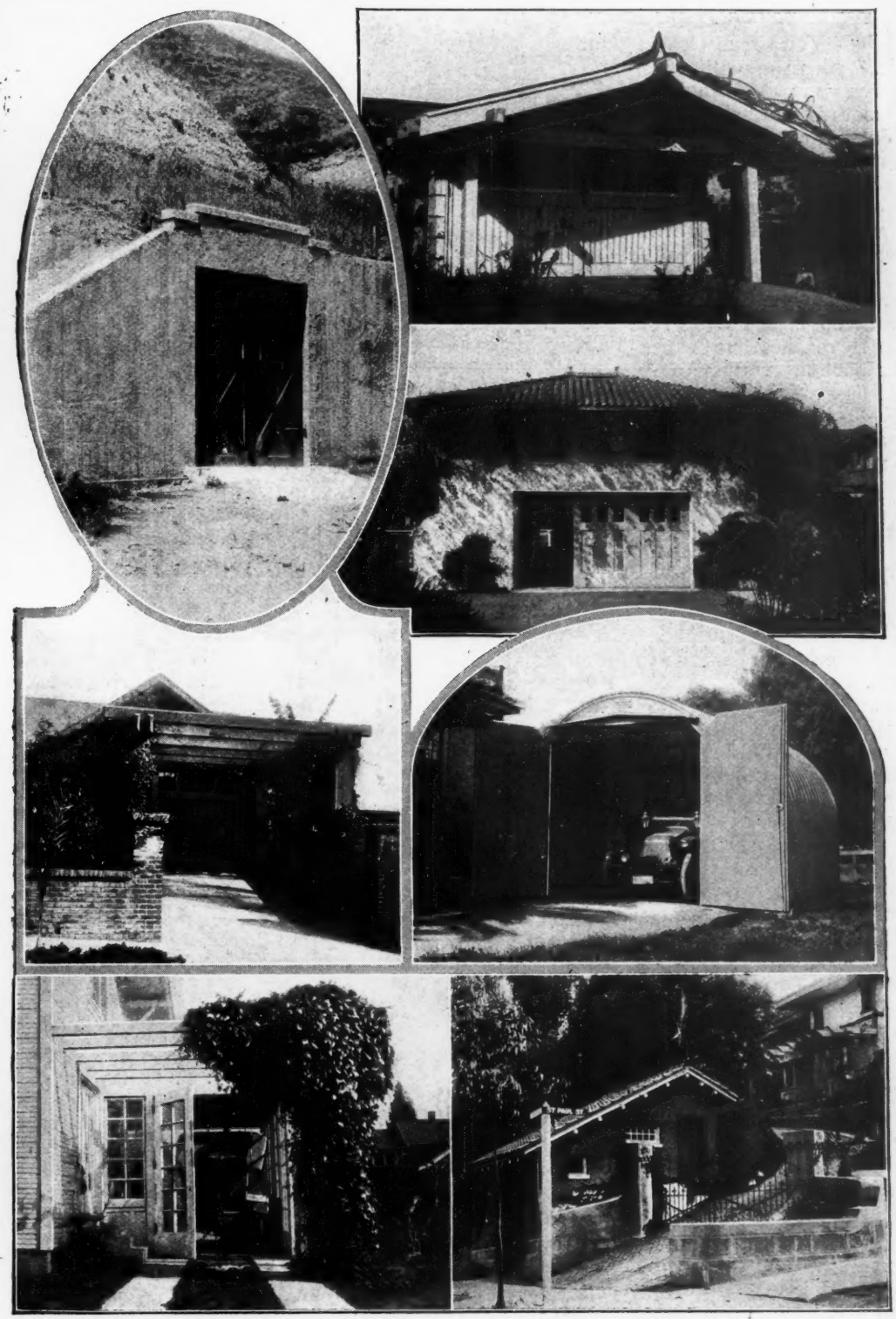




THE automobile enthusiast thinks of his car as something human. It is only natural, then, that he should plan its "sleeping quarters" with almost as much care as he would his personal residence. In fact the garage should be treated as a part of the homeplace, if it is located on the same plot. It should be constructed of the same material and along the same lines as the house, and should be painted the some color. In the accompanying photographs picturesque effects have been studied. On the left is a clock-tower garage erected on an elaborate suburban estate. Other designs show the garage incorporated in terraces and a hillside, leading to the dwelling. The rounded sheet-metal type is becoming popular, and the all-glass model in the lower left corner of the following page provides abundance of light. Flowers and vines relieve the coldness of concrete or extremely plain structures.



Stabling the Gasoline Horse at Home

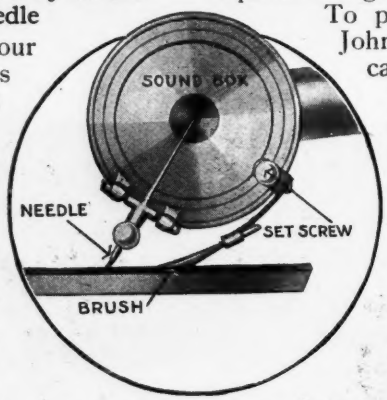


A Brush Which Clears the Way for the Phonograph Needle

DO YOU really clean your phonograph records when you rub them off with a cloth? Doesn't the rubbing compress some of the dust into the grooves?

Arthur Herrman, of New York city, thinks so. He has taken an ordinary brush and has attached it to the sound box in such a way as to dislodge all dust from the groove just before the needle reaches that particular portion of the groove.

His sweeper is composed of stiff bristles. It may be swung to an inactive position out of engagement with the record by turning it on its swivel connection. It is adapted for the playing of records having hill-and-dale or laterally cut grooves.



The sweeper is clamped to the sound box and is moved along just in front of the needle

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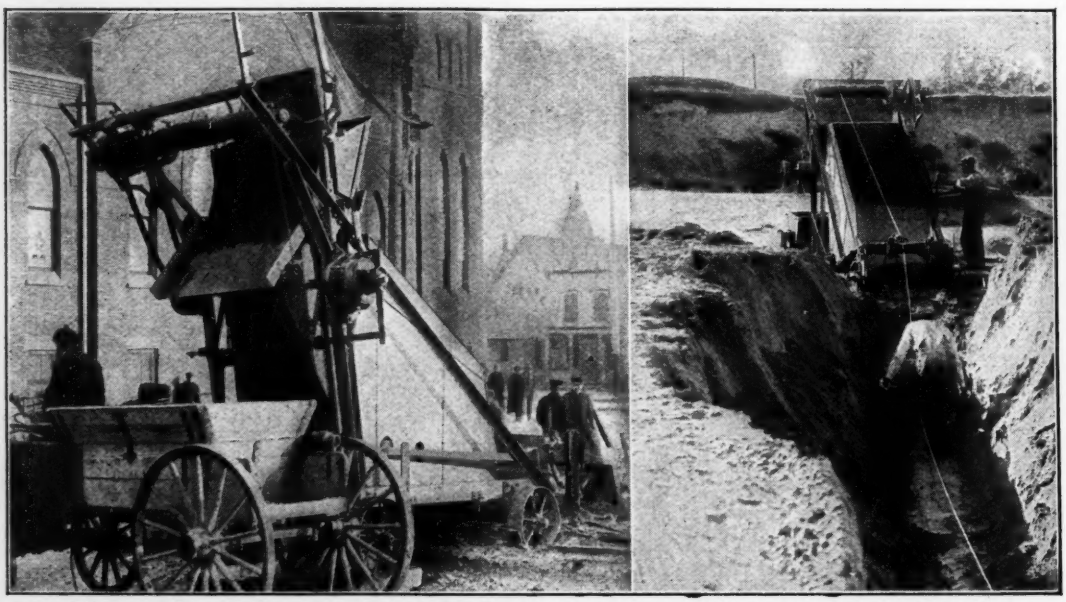
Doing Away with the Pick and Shovel in Excavations

UNTIL recently there were only two methods of excavating and handling dirt, stone and gravel. The one was by means of the pick and shovel, which is both expensive and slow. The other was by means of the steam shovel, which, while cheaper and quicker than the first way, requires a large original purchasing outlay. To provide a happy medium, John Albrecht invented this excavator and loader.

The machine consists of a scraper and a loading platform. The scraper is of steel and scrapes up the dirt or gravel and carries it to the loading platform. It is pulled back and forth over the ground by a steel cable. A man guides it by two wooden handles. When the scraper reaches the platform it is full of dirt and ready to be dumped into a wagon. To do this it is drawn onto a skip, or steel box with only three sides. The skip is then lifted till it holds the scraper directly over a shute down which the dirt slides into the waiting wagon.

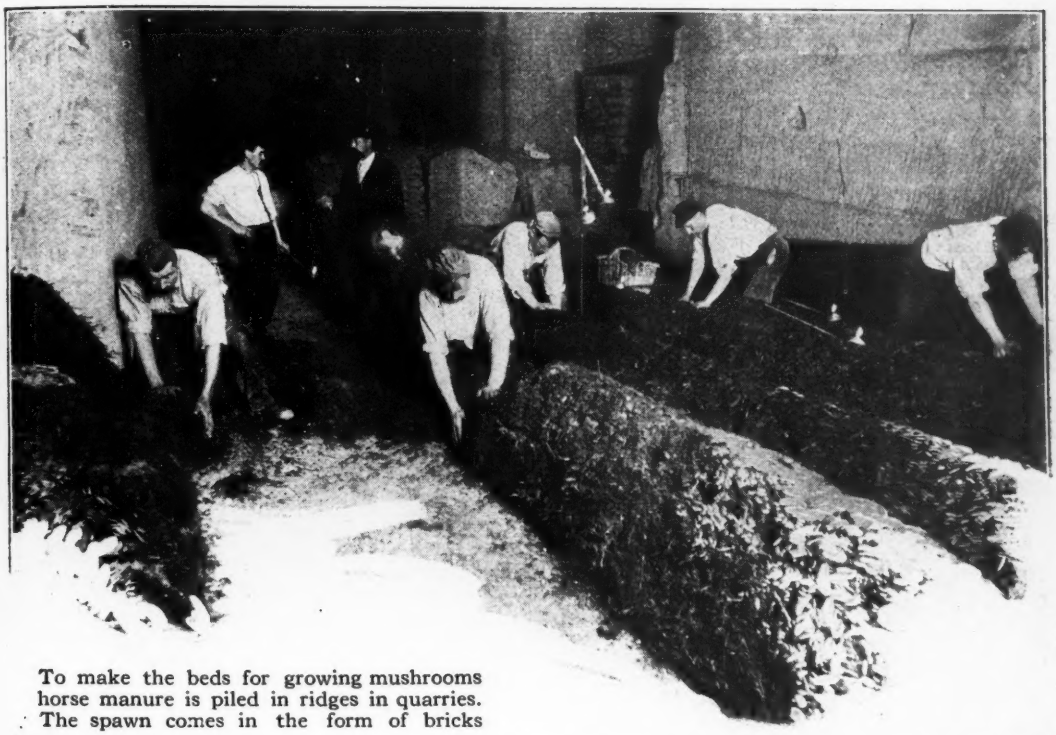
The machine is run by an electric motor and needs only two men to operate it, one to run the motor and the other to steer the scraper. When this excavator is used the wagons are loaded with dirt on the street instead of having to be driven into the excavation to be loaded, which would necessitate an extra team of horses to pull them out. In this way the great gap between the expensive steam shovel and the old hand method is bridged.



The machine consists of a loading platform and a scraper, which, when filled with dirt, is drawn up on a three-sided steel box which dumps the dirt into the waiting wagon

Farming in Your Cellar

The French may lack land, but never ingenuity. So they cultivate p'ants which thrive without sunlight



To make the beds for growing mushrooms horse manure is piled in ridges in quarries. The spawn comes in the form of bricks

THE underground cultivation of mushrooms is a large industry in the vicinity of Paris. The kind ordinarily grown is the common mushroom, the variety best understood by cultivators. No one knows the name of the genius in gardening who first took the spawn from the half-decomposed bed of dung where mushrooms had grown and then sowed it in fresh dung to obtain a second harvest. This method of "cellar farming," as it may be called, arose in France in the latter part of the eighteenth century, but long before that period a cultivator named Chambry conceived the idea of turning abandoned subterranean quarries into mushroom-beds. The large profits he realized led a swarm of imitators to rent all the deserted quarries. Thus the raising of mushrooms became an established industry.

Nowadays, these subterranean mushroom-beds near Paris are on the left bank of the Seine, largely in the district between Meudon and Ivry. Formerly the galleries ran as far as Paris, existing under the quarter Val-de-Grâce. Of late years other excavations have been made in the suburbs between St. Germain and Argenteuil, while still others are to be found on the other side of Paris, between Romainville and Noisy-le-Sec. Modern facilities of transportation have led to the making of beds farther off from Paris in the valley of the Oise near Creil and Meru. The galleries are cut either in gypsum as at Argenteuil, or in white chalk, as at Meudon. The oldest of the galleries form labyrinths of narrow passages so low that workmen cannot walk through them without stooping.

After securing good ventilation in an abandoned quarry a well is dug to make sure of the large amount of water necessary. After this, horse manure is prepared by piling it in heaps about a yard high. Sometimes a pile will contain a thousand wagon loads of material. The heap ferments in the air for three weeks, and is turned from time to time to check excessive fermentation. The mushroom does not develop properly in fresh manure. Fermentation gives the manure the necessary nutritive properties. After about twenty

days the manure is taken down to the beds where it is carefully heaped in ridges along galleries with rough walls. Small bricks or "leaves" of mushroom spawn are inserted in holes made in the ridges. The growth of this spawn, called by botanists "mycelium," is checked by dryness and quickened by humidity and heat. The spawn throws out threads which spread in all directions and finally fill the entire ridge of manure.

Entrance to a subterranean mushroom bed near Paris. In many places abandoned quarries are utilized in this way

Mushrooms Require As Much Care As a Baby

The skill of the cultivator reveals itself in adjusting local conditions to the requirements of his beds. The chief difficulty arises from the enormous amount of air absorbed by mushrooms. They die of suffocation easily. Not only must the galleries be thoroughly ventilated, but the air must be moist and changes of temperature must be avoided. Verily, young mushrooms are frail.

The three kinds grown in the underground beds around Paris are: the white, which is small and delicate in flavor but does not bear transportation well; the light yellow—stronger, more productive and less fragile than the first, and the gray. This last has a rich odor, but the deep color acquired at a late stage of growth lowers its price in the markets. The "sets" of spawn introduced into the manure degenerate after a while, so that raisers seldom cultivate from one seeding more than two or three years. They prefer to take fresh spawn obtained by scientific methods which allow a selection of mushrooms, and then to reproduce the best by direct germination of the spores.

There are in the Department of the Seine two hundred and fifty mushroom-beds, some of great extent, owned by eighty proprietors; the annual value of the yield near Paris is about $2,500,000.

Other vegetable growths also receive subterranean cultivation both in other parts of France and elsewhere. French and Belgian market gardeners grow certain vegetables out of season and blanch them underground, one of the most curious examples of the method being the cultivation of wild chicory, a form of endive. Celery and plants of similar nature are also grown and blanched underground.

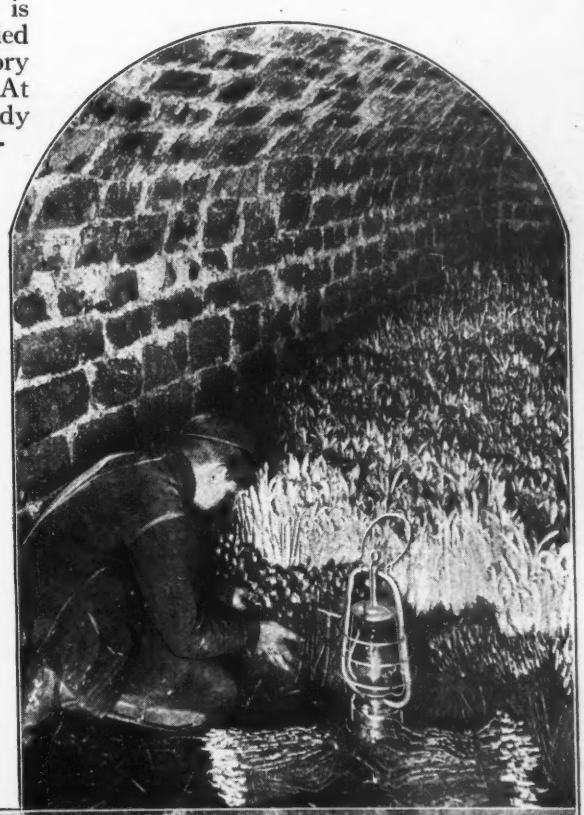
Cutting potato sprouts with pruning shears after three weeks of growth in the underground molds. About three months later the potatoes are large enough to be marketed

Growing Other Vegetables in Cellars

Near Paris seed is sown in the open air between April and June. At the beginning of winter the young chicory is taken up, the leaves cut off just above the neck and the chicory placed in heaps covered with leaves in a shed. A layer of manure is arranged in a dark cellar, and the roots tied in bundles are set in it. The chicory shoots out rapidly in the warm air. At the end of two or three weeks it is ready to use; no care is needed except occasional watering.

Early potatoes have also been grown underground. The potatoes are placed on beds of garden mold laid on planks two feet from the ground. The cellar or gallery must be absolutely dark. After three weeks the potato sprouts are cut down several inches. Two or three months later the sprouts are surrounded by a number of small white potatoes. The growths can be arranged so as to have a succession of new potatoes from October to March, when they arrive from the south. The method although ingenious, has not proved to be very profitable.

So far as mushrooms are concerned they can be grown almost anywhere out of doors and also within doors, according to the Department of Agriculture. Where there is a dry bottom on which to place the beds, where a uniform and moderate temperature can be maintained, and where the beds can be protected from wet, winds, draughts, and direct sunshine mushrooms will thrive.



At right: A bed of endive in a subterranean passage. The cellar farms have been found especially useful for blanching vegetables

Placing potatoes in a mold. The plantings are arranged so as to provide for a succession of new potatoes from October until March, after which time the demand is supplied from the South

Testing Your Camera Lens

How photographic lenses are given the third degree to unveil possible serious faults

The lens is put in its holder on top of its own column. At the end of the microscope is a camera in which is a strip of motion-picture film for taking pictures of a point of light

THERE are several ways to "try" lenses—and many devices for the purpose. A camera is only as good as its lens, and the more severe the manufacturer is toward his lens children, the better.

When the lens-tester illustrated here gets through with a lens, he knows all about it. Its innermost secrets are all revealed. If a lens shows partiality to certain colors, which it should not, the tester finds it out. If the lens is suffering from astigmatism, the tester will show it. If it casts a drunken image, it has no chance of escape.

Next to a meteorite, the bench for testing lenses is about the heaviest thing for its size in existence. One is impressed, therefore, when he discovers that it is built to hold a small microscope and a wee little lens about as heavy as a wet feather.

Why should such an elephantine machine be necessary to test lenses? Because the test must be made without vibration, and the distance between lens and microscope must be known within one ten-thousandth part of an inch. Perhaps the heavy parts now begin to explain themselves.

Before we describe this method of lens testing used in the kodak research laboratory, it will be well to review the lens from its beginning.

If you have ever forced a stick into a clear pool and observed how curiously the reflection is bent, you have the working analogy of what a lens does to light rays. Refraction, as it is called, is that property of a substance which bends light rays, or, to be more accurate, which changes their direction. In the case of a lens, rays are bent so as to converge at a common point known as the focus.

Simply stated, the problem is to grind glass into the proper curvature so as to focus rays at a given point. But the implied simplicity of this statement is most misleading. The difficulties that beset this curve grinding are legion.

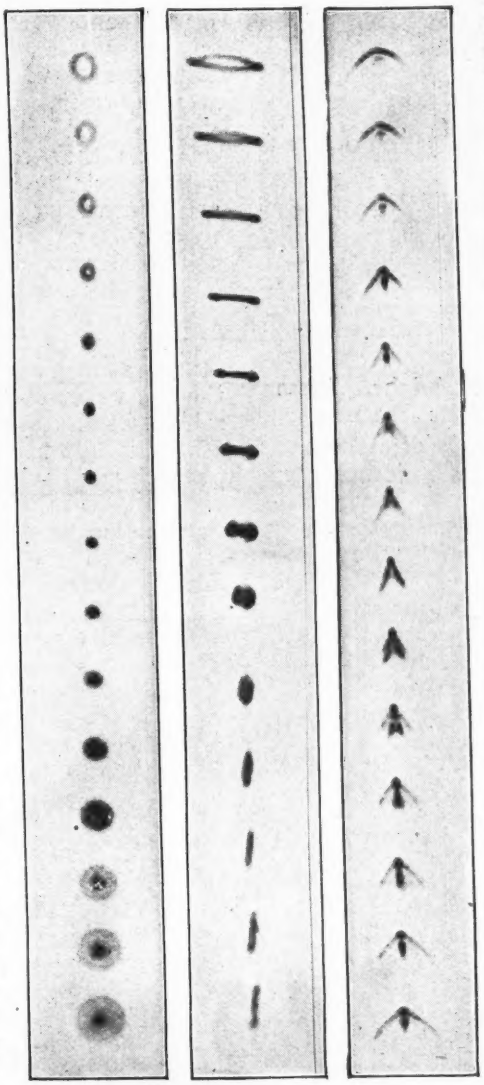
At the very outset in lens-making the

manufacturer is faced with one insurmountable difficulty—in grinding photographic lenses he can produce only spherical surfaces. He can't grind glass into parabolic curves; the basic principle in grinding precludes that. So the lens maker, to overcome these difficulties, has to use several kinds of glass and to combine the lenses made from these various kinds of glass so to make the finished photographic objective. He grinds some glasses with deep concave curves, some with convex curves. Wherever he can get two curves that will fit—one being concave and one convex—he cements the glass surfaces together. And so he persuades the lens to carry out his primary object and bring together at a point on the film the different light rays reflected from the same point in the object.

The genesis of every lens is a design on paper. The lens is calculated by a lens-computer, who is as much at home with abstract mathematics as a baker at his doughboard. After he has computed the lens, he passes it on to the workman, who grinds and assembles it exactly according to the calculation. The computer then submits his lens to test on the lens bench. On the other side of the room is a tiny pinpoint of light, very brilliant, and so arranged that its color can be varied. By this means the bench can test a lens not only for ordinary light, but for red and green and yellow and blue light as well.

The lens is put in its holder on the top of its own column (see illustration on preceding page). It forms a tiny image of the point of light across the room, which point of light is examined by the microscope. At the end of the microscope a little camera is placed, in which is a strip of motion-picture film. On this strip of film, pictures are taken of the point of light.

The vertical strip at the left in the illustration below shows the sharpness of the image that the lens will give in the middle of the picture when the light is going straight through the center of the lens. But at the edge of a picture the light is not going straight but sideways through the lens, and the real test of a photographic lens is the sharpness of the edges of a picture. Nearly all lenses will give a sharp picture in the middle of the film, but only a really good one will give a sharp image at the edges.



Illustrations of the point of light. The strip at left shows a sharp picture in the middle of the film but blurred ends. The center strip shows astigmatism, the lines changing direction. At right is the blurring called coma

Sometimes instead of getting a point image at the edge we get a short line which changes its direction according to the exact focus of the lens, the line being vertical in one position and horizontal in another. (See middle strip in illustration.) This defect is called astigmatism. An even more curious defect is the blurring known as "coma," the point being shown as a dot with luminous wings like those of an insect. (Vertical strip at right of illustration.)

The lens-testing bench measures exactly all the deviations of the lens from its theoretical perfection. Armed with this knowledge, the lens-computer can draw his curves and alter his construction until the lenses measure up to the highest standard.

Press a button in the door-knob and a lamp near the keyhole flashes up

Finding the Keyhole at Night. Press a Button and a Light is Made

SOME people, on certain dire occasions in the small hours of the morning, find it difficult to locate the keyhole of their door. An Ohio inventor, however, has come to their rescue with a device for luring the latchkey to the proper place. He accomplishes this with an arrangement which provides for the placing of an electric light pointing geometrically toward the keyhole. The light has a reflector attached to it which further intensifies its illumination. The connections to the light are made through a push-button which has been thoughtfully fitted directly into the door-knob. From the push-button, the wires lead to the batteries through contacts between the door and the door-sill. Push the button and the circuit is closed and the lamp lighted.

Combined with this is an alarm which is so connected with the door-lock that as soon as the key is placed in it, the alarm goes off, arousing the household.

How They Wash Clothes with the Help of the Wind in Alaska

IN Alaska and throughout the more or less frozen North, laundresses are practically unknown. The miners do their own housekeeping, and their own laundering. The accompanying illustration shows a device which one of them constructed as a substitute for the washboard and tub. It is made of an old barrel-churn mounted on runners so that the miner can take it along to his work.

A cylinder about thirty inches long and of the same diameter as the head of the churn was first constructed of heavy galvanized iron. One end of this cylinder was left open, and the head of the churn was fastened to the open end. The cylinder was then carefully balanced in the churn, and the churn-bearings were fastened on with rivets and solder to make them watertight.

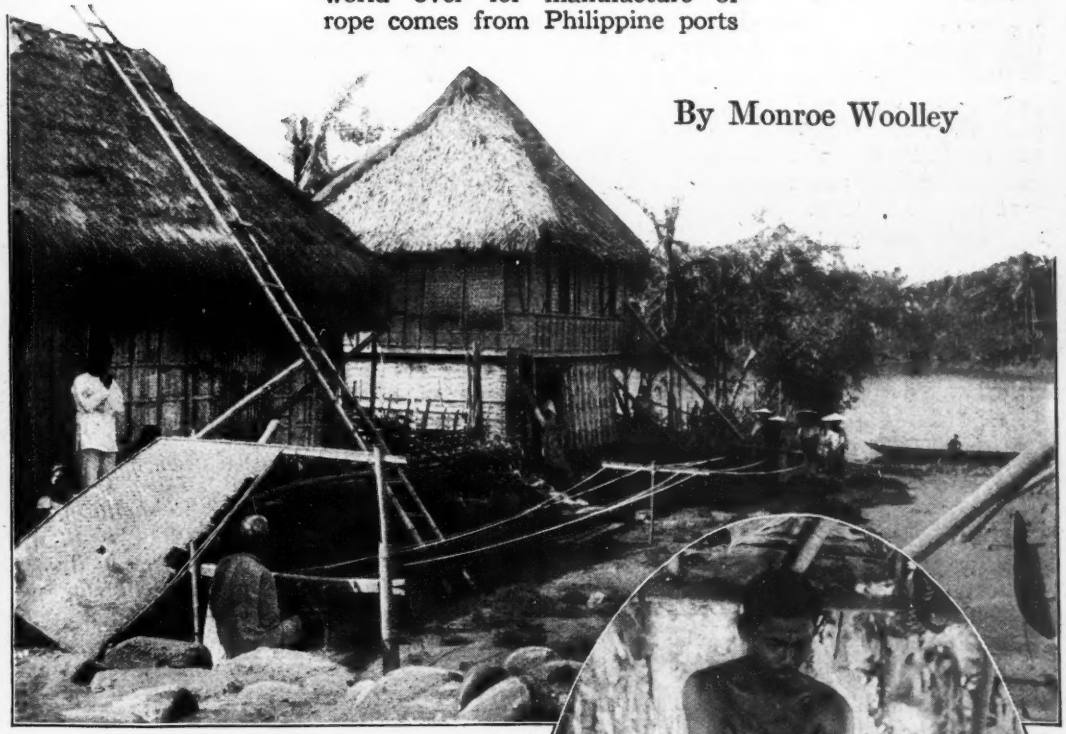
Two screens of galvanized wire of one-inch mesh were made. One of them was suspended from the movable head by one-quarter-inch galvanized iron rods, and the other was fastened to the cylinder, so that the two were about ten inches apart in the middle of the cylinder. The clothes are confined between the two screens. The water surges back and forth through them until they are clean, or as long as the churn is in motion. A large pin-wheel attached to the bearings furnishes the turning power.

The miner leaves the machine in an exposed position and lets the wind do his washing

Rope Riches of the Philippines

Practically all the hemp used the world over for manufacture of rope comes from Philippine ports

By Monroe Woolley



A typical Manila home showing the crude methods which the natives employ for stretching and drying the rope material

MANILA paper rarely sees the light of day in Manila. It may be included in the only paper-making plant in the islands, just started by Americans, but that is not likely. In fact, Manila paper has nothing to do with Manila at all. Like Manila paper, Manila rope was unknown in the Philippines until Americans established a modern rope factory in Manila. It is true that the natives made rope, miles of it, before our advent, but the crude, hand-made output of the peasantry was rarely exported—at least little in finished form came to us.

The Philippines are rich in rope material. Manila hemp is known over all the world because it finds its way wherever railroads, steamships, caravans, and dog-teams travel. The hemp plant, which cannot be distinguished from the banana plant by those unfamiliar with the subject, thrives best in a volcanic soil. Soil of this

Hemp stripping by hand is muscle-developing but slow. The bark is drawn over a toothed knife to tear away the pulp

class is common over the entire Philippine archipelago. Due to this fact, practically all of the hemp used in the world for rope manufacture comes from Philippine ports.

Silk and hemp are the two commonest cargoes carried by trans-Pacific ships when coming our way from the Far East. The British have always controlled the hemp growing industry of the Philippines. They controlled it in Spanish times, and they control it now. The natives raise it and the British buy and market it. Why this is so is a long story. Briefly, the situation may be traced to unsettled political policies.

A small crop of hemp and the apparatus used by the natives for stripping the threads from the stalk

American firms hesitate to invest capital in politically turbulent countries.

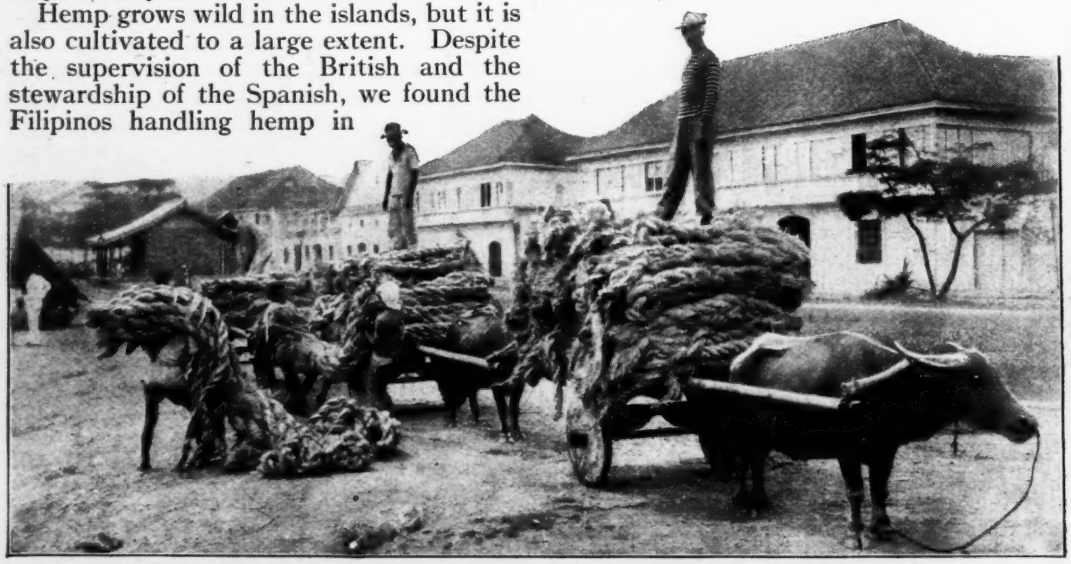
Hemp grows wild in the islands, but it is also cultivated to a large extent. Despite the supervision of the British and the stewardship of the Spanish, we found the Filipinos handling hemp in the very crudest way when we became overlords. Stripping hemp by hand meant hard work. Much of the crop was wasted, too. For this reason prices were high.

Hemp threads are stripped from the trunk of the plant, a long green log, similar to an overgrown cornstalk. The strip, or bark, is drawn over a toothed knife, so that the pulp is torn away from the threads. Americans were quick to see that a machine could be applied to do this work, and to do it better and very much faster than by hand.

So alluring were the fortunes to be made from such a machine and so great was the need for it economically, that several successful hemp-stripping machines appeared on the market at about the same time. These machines are doing good work, but the poorer natives have been slow to adopt them because of a lack of money and because a machine that will do the work of ten or twenty poor peasants is looked upon as an industrial enemy.

Hemp stripping by hand is healthful work. It develops rolls of hard muscles and affords fresh air, as the operations are usually carried on in the field. Pulling the pulpy slabs across the toothed knife is muscularly like boat-rowing. Natives having a small crop, bale it up and carry it into town on their shoulders for sale to the nearest agent of the British exporters.

Native hand-made rope is too loosely woven together to have much commercial value outside the islands.



Silk and hemp are the commonest cargoes from the Philippines. Hemp grows wild in the islands and is also cultivated by the natives to a great extent. The British control the trade

Americans quickly noted that while all the raw material for rope, the world over, came from Manila, little factory-finished rope was going abroad. As a result an American company was formed and a modern plant for rope-making was built in Manila.

The natives do make rope but it is too loosely woven to have much commercial value. An American plant has now been established in Manila and modern machinery installed

A good hemp rope is hard, but pliant, yellowish or greenish gray in color, with a certain silvery or pearly luster. A dark or blackish color indicates that the hemp has suffered from fermentation in the process of curing, and brown spots show that the rope was spun while the fibers were damp, and is consequently weak and soft in those places. Sometimes a rope is made of inferior hemp on the outside, covered with yarn of good material. This may be detected by dissecting a portion of the rope. Other inferior ropes are made from short fibers, or with strands of unequal lengths or uneven spinning, the rope in the first place appearing woolly, on account of the ends of the fibers projecting; in the latter case the irregularity of manufacture is evident on inspection.

A test for ascertaining the purity of Manila rope consists in forming balls of loose fiber of the ropes to be tested and burning them completely to ashes; pure Manila burns to a dull grayish-black ash; sisal leaves a whitish-gray ash; a combination of Manila and sisal yields a mixed ash. Manila hemp is frequently adulterated with New Zealand flax and Russian hemp, both of which are much inferior in strength.

Rope in service deteriorates in two ways: the wear on the outer surface, which can be readily seen and the stretching, bending, crushing and breaking of the inner fibers, which cannot be discovered without a careful examination. It is when rope is to be subjected to such severe bending and rough treatment that preliminary oiling of the fibers is important, if the life of the rope is to be long.

Cargoes of hemp ready for shipment to England and western ports. All the raw material for rope comes from Manila, except certain inferior grades made from flax and Russian hemp

Combination Christmas Tree-Holder, Telephone Stand, and Tabouret

A CHRISTMAS tree holder has been invented which will prevent the usual litter, because it keeps the base of the tree in water. This keeps the branches fresh and alive so that the "needles" are not so prone to drop off. The device may also be used as a telephone stand, a jardinière stand, a vase support, or a hanging flower-pot holder.

When the device is used as a Christmas tree holder, the tree stands in a cone with the pointed end down. This may be filled with water to keep the branches supplied with moisture, so as to preserve the greenness for the longest possible time. Thus the danger of fire is diminished, although it is ever present where the old-fashioned candles are employed. The total elimination of the fire danger is accomplished by the use of electric-light sets, which are supplied with varicolored bulbs and batteries complete at hardware and department stores.

The holder is adjustable for various sizes of trees. The legs may be detached and the cone suspended as a hanging flower-pot. The Christmas tree may be trimmed, sawed off at the proper height, and a board attached to make a telephone stand or tabouret.

The receptacle for the water does not touch the floor. Hence, there is no damage to polished surfaces from sweating.

The tree is held rigidly upright with its stem in a vessel of fresh water

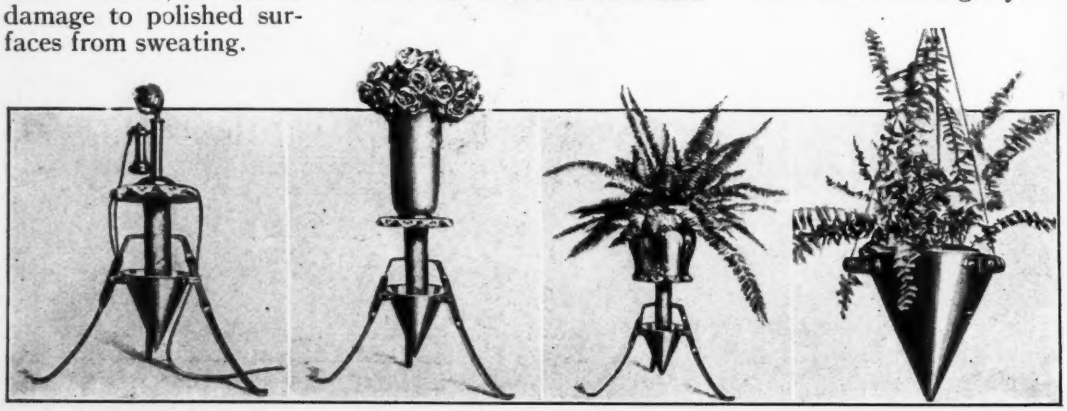
How Do Birds Always Know Where They Are?

PROFESSOR K. S. LASHLEY has completed an investigation of the sense of direction in birds. This is called the problem of "orientation." To "orient" means in straight English to know where you are.

Dr. Lashley used the wild birds of the Florida Keys, known as noddy and sooty terns, in experiments. In their recognition of their nests, it was found that their eyes as well as their muscles are concerned. The birds showed no evidence of any special sense of locality such as a "magnetic sense" or a "second sight." Birds are no more "mind readers" than men are.

Nor do they have any ability to retrace their paths of flight by memory. They recognize their nests and their own young by muscle habits and eyesight.

Dr. F. A. McDermoth, another investigator, has observed the oddities in the behavior of houseflies. They have a strong tendency to go with air currents between 80 and 100 degrees. This explains why flies are so bad in hot weather, when it is about to rain. The heat usually ranges upwards towards one hundred, and the air travels along too slowly to cause the vapor in it to evaporate. The heat, humidity, and slow movement of the air gives the housefly its "fly time." As pests, they are then in their glory.



The Christmas-tree support has all-the-year-'round uses. It makes an attractive telephone stand, tabouret or flower-stand, and may even be used for hanging plants

A Rain Alarm to Make the Hired Girl Get Up and Close Windows

ONE of the countless young American geniuses for whom is waiting the worthy task of carrying out some unrealized ambitions of Thomas Edison, has laid claim to national attention by the invention of an alarm apparatus which will wake up the housemaid by the loud clanging of a bell when the weather becomes rainy. The sixteen year old Edison in question lives in Minneapolis. His deed was inspired by his worried mother, who complained that nobody woke up in the night when it rained, and that the water came in at the windows and ruined window curtains, rugs and other household valuables.

The boy, who is a wireless enthusiast with an inner knowledge of the pranks that the electric current can be made to perform, got out wire, batteries, and tools, confiscated several articles from the kitchen, and set himself to the task.

The first drops of rain trickle down from the gutter to the funnel leading to the battery and cause the contact which rings the alarm

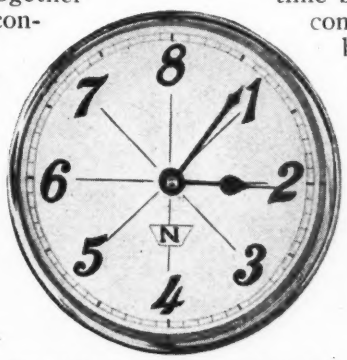
At the base of one of the gutters leading from the eavestrough he attached a device for making electric contact as soon as the first few drops of rain fell. This device consists of a tin funnel beneath which is placed a jelly-glass having two strips of spring-brass attached to its sides and terminating in its center. The strips are adjusted so that, when released, they spring together and send the current from conveniently located batteries surging through a bell. Crystals of coarse salt hold the springs apart. When water touches the crystals they dissolve. Thus contact is made. Even if the salt should not dissolve it will be saturated sufficiently to allow the current to pass.

Wires lead from the brass springs to several dry cells. A bell is located at the head of the housemaid's bed.

The raindrops trickle down the eavestrough to the gutter, through the funnel and on until the contact is made which rings the bell.

An Eight-Hour Clock for the Eight-Hour Day

HARDLY was ink on the eight-hour law dry, when a California watchmaker devised the "eight-hour clock" and at the same time offered a plan for abolishing the confusion arising from the difference in time between various points on the continent. The new clock has but eight figures on the dial, with a small square in the center which shows *M* from one in the morning until eight; *N* for noon, and *E* for evening, the third division.



The eight-hour clock designed to abolish computations of time

The inventor makes this suggestion: Inaugurate a uniform time all through the United States, and let Washington, D. C., be the heart of our time system.

The twenty-four hours of the day can be divided into three sets of eight hours and the different divisions indicated as *M*, *N*, and *E*, or D1, D2, and D3. This would eliminate time-computations.

The massaging is accomplished by the alternating inflation and deflation of the attached tubes

A Machine that Massages Your Pains Away with Air

AN air-operated massage apparatus with action somewhat like a milking machine has been devised by Frank and Wilfred Shurtleff, Moline, Ill. Elastic tubes are attached to the inner portion of a broad belt, and into these, flexible air-pipes are led. Air is pumped through these pipes by a pump driven by an electric motor.

As the tubes are alternately inflated and deflated, they perform a constantly shifting or massaging action without discomfort to the patient. The two pump-cylinders are connected by a bypass with a valve to regulate the pressure of air in the massaging tubes. Belts of different sizes may be readily attached to the apparatus, making it adaptable to a variety of treatments.

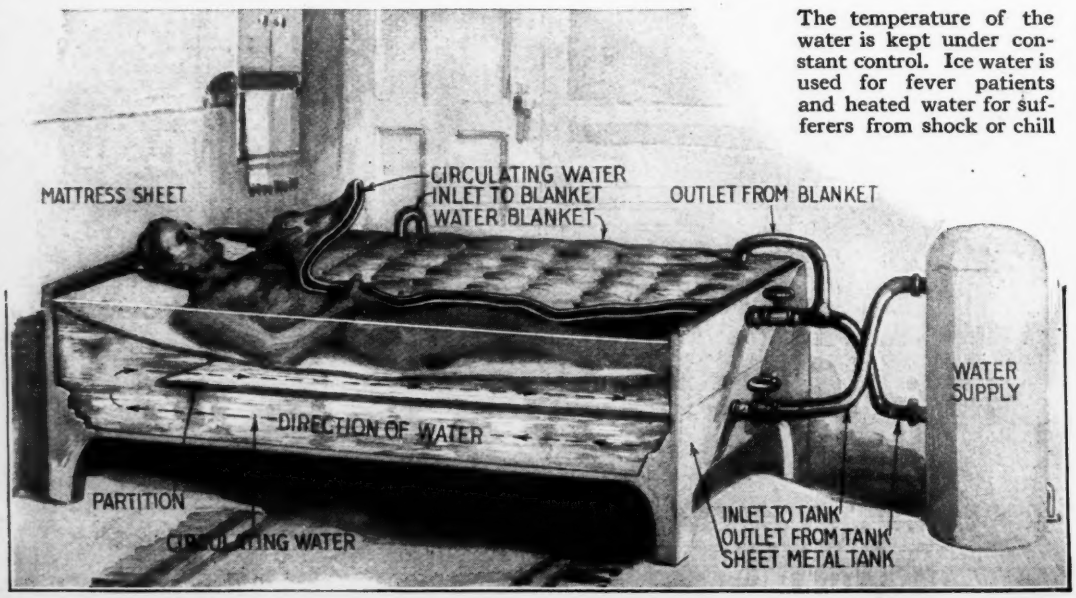
Sleeping on a Mattress Filled with Water

ONE of the things needed by physicians is a bed that can be heated or cooled according to the needs of the patient, and one that a patient can lie upon for months, if necessary, without getting bed sores. An inventor has filled this want with what he calls a water bed.

The bottom and sides of the bed are built of galvanized steel, and the top is made of rubbered canvas. When this is filled with water it makes as soft a mattress as any one could desire. A reservoir is stationed at the head of the bed, which holds enough water to make the pressure in the mattress the same at all points.

The reservoir will hold one hundred pounds of ice for keeping the bed cool and comfortable for typhoid fever patients or for anyone in the summer time.

Under the foot of the bed is an oil stove which has a flue that runs under the center of the bed to the head. This artificial heat would be useful in case of a patient who was suffering from surgical shock, hemorrhage, chill or collapse. A thermometer is attached.



The temperature of the water is kept under constant control. Ice water is used for fever patients and heated water for sufferers from shock or chill

How the Forest Service Gathers Pine Seeds

Nature has tucked away the pine seeds so carefully that it requires ingenuity to extract them

GATHERING seed of various species of pine trees is an industry carried on in the great national forests of the West by the United States Forest Service. The seed is used for reforestation on the government reservations and is also sold to private persons for the same purpose.

Each autumn the cones are both gathered in large quantities by employes of the Forest Service and bought by the bushel from persons who make a business of gathering them. When gathered, the cones are closed and hard and contain much sap. They are placed in bins under cover and allowed to dry out for a period of two months or more. The opening process is hastened by subjecting the cones to a heat of about one hundred degrees Fahrenheit for a period of from one to three days.

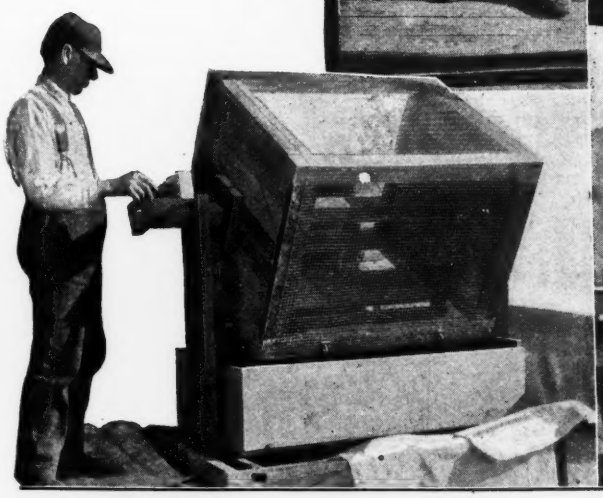
The cones are placed in wire-bottomed trays, about two feet wide and three feet long, and the trays are stacked on racks in a room where the drying process is carried on. The drying causes the bracts or petal-like parts of the cone to spread out, thereby releasing the seed.

In order to shake the seed from the cone a churn-like device is utilized. It consists of a box with ends of boards and sides of woven-wire screen. Through this passes a wooden axle supported by uprights. By means of a handle at one end of the axle the churn is revolved rapidly; the seeds are shaken from the cones and fall through the wire screen to a sheet underneath.

In order to separate the seed from their "wings," which are broken off by the violent churning of the cones, a fanning-mill is utilized.

In the southwestern section of the country the use of a drying room or kiln is not necessary in order to open the cones and extract the pine seed. The cones are placed in shallow bins in the open air. Exposure to the intense heat of the sun soon opens them up, whereupon they are put through the churn.

The cones are gathered in large quantities and stacked in wire-bottomed trays to dry



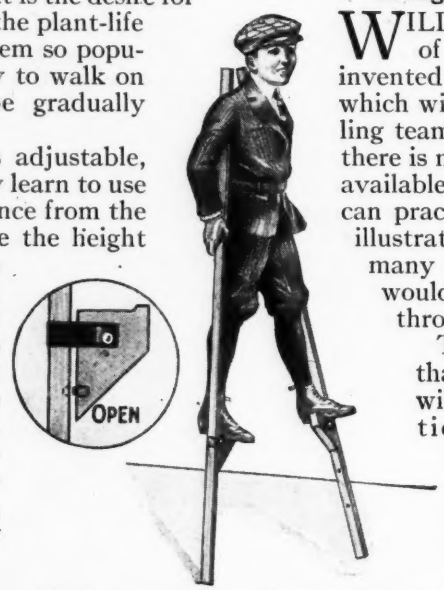
A churn-like device is revolved rapidly to extract the seeds from the dried cones

Pouring the cones into the churn. The seeds fall into a sheet-lined bin below

With Adjustable Stilts a Boy Can Grow Up in a Minute

NO one remembers who invented the first pair of stilts. Fathers, grandfathers and as many "great-greats" as a youngster might ask, would all admit that it was before their time. Yet the charm of the stilts is as insistent as ever, especially in the spring-time. Perhaps it is the desire for quick growth which even the plant-life is feeling, which makes them so popular. But often the ability to walk on very high stilts must be gradually acquired.

This pair illustrated is adjustable, so that the boy or girl may learn to use them at just a slight distance from the ground, and then increase the height at pleasure. The supports for the feet are firmly fixed in the sockets made for them, so that there is no danger of accidents from their loosening. The sockets make half a dozen different adjustments possible, and if a boy's ambition soars still higher, other holes may be easily made.



The foot supports are fastened securely in sockets and strapped to the poles

Every Time We Wink We Give the Eye a Bath

EVERY few seconds we wink both our eyelids at once, although not purposely. If we stop winking, our eyes become uncomfortable and gradually cease to work as they should. When the eye is open the front of it is exposed to dirt and dust and is apt to become so dry that a painful stinging sensation results or would do so if constant moisture were not provided to cleanse and soothe the tissues.

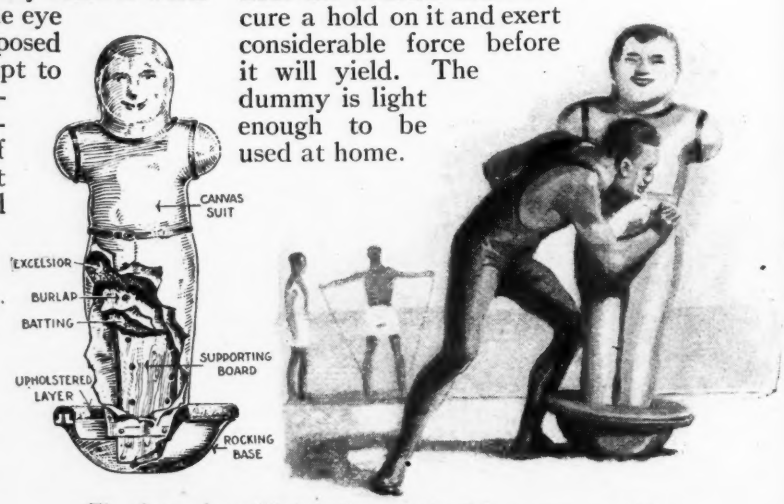
As a matter of fact each time we wink we wash the eye. Up above each eye is a tiny water bag called the tear gland, and all the time we are awake it makes tears. When the front of the eye feels itself becoming a little too dry or dusty a communication is sent for a supply of moisture. The eyelid then comes down with a tear inside it to wash clean the front of the eye. This is the most gentle and perfect washing in the world.

A Wrestling Dummy Which Welcomes Rough Handling

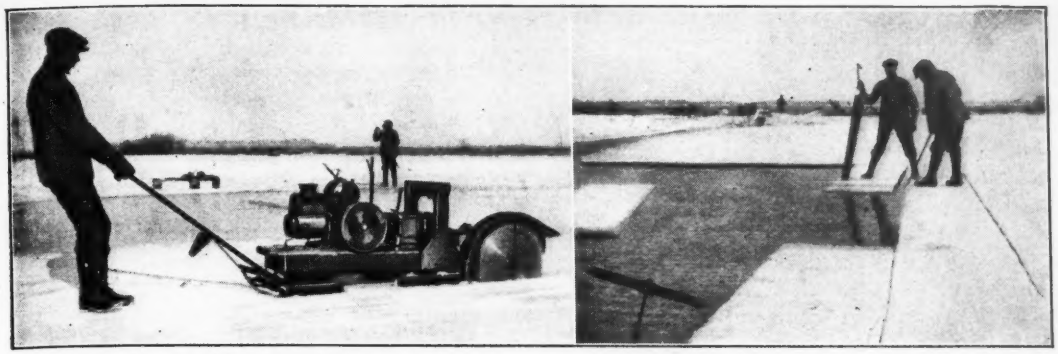
WILLIAM P. ARMSTRONG of Washington, D. C., has invented a wrestling dummy which will find favor with wrestling teams. At the present time there is no gymnasium apparatus available with which wrestlers can practice. With the dummy illustrated they can go through many of the movements they would assume in tackling and throwing a living opponent.

The figure is shaped so that no protruding points will injure the one practicing with it. The head portion of the figure is nearly round, the arms are stubbed, and the base, although heavy, is padded and upholstered. The entire body consists of a canvas suit fitted over raw cotton, excelsior, hair or any other yielding material. The device is supported on an upright board embedded securely in the base of heavy wood.

In order to throw the figure to the floor the wrestler must secure a hold on it and exert considerable force before it will yield. The dummy is light enough to be used at home.



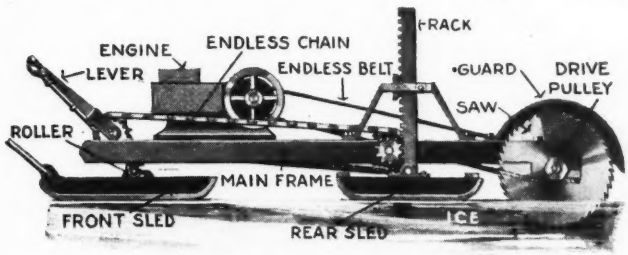
The figure is padded and covered with canvas so that it can be pounded vigorously without any harm being done



The sawing machine is pulled along at a leisurely rate, the saw cutting the ice in any direction desired. The illustration at right above shows the old method of sawing the ice by hand

It Bites Its Way Through the Thickest Ice

THE natives about a small lake in Iowa were stupefied when ice-cutting time came around to see what appeared to be a motor sled, similar to the ones they had seen pictured in the magazines, slide out over the glazed surface of the frozen lake, sink what appeared to be a large driving wheel into the ice, and emit a loud scream. This contrivance was not a motor sled,



The saw can be raised or lowered so as to be accurately set at the proper elevation

but a brand new type of ice-cutting machine, equipped with a gasoline motor, and the scream that made them look to their life preservers, was the shrill sound of the whirring saw as it bit into the ice. When they went out and looked the machine over they found, as intimated, a squat, rigid sled upon the deck of which a lusty one-cylinder gasoline engine was bolted. A belt communicated the power to a circular saw located aft, which was driven at amazing speed.

The inventor, who is John Hill, of Story City, Iowa, demonstrated the machine, showing that it could rip a straight line through the ice at a speed which made the ordinary up-and-down sawing method seem to stand still. By a simple arrangement the saw could be lifted off the ice or lowered upon it with little effort.

How Do Fish Locate Fresh-Water So Unerringly?

HOW salt-water fishes determine where they are, and why fresh-water fishes can always find their way into rivers is made clear by Drs. V. E. Shelford and E. B. Powers. Their studies on the resistance of salt-water fishes to the decayed and decomposed things, lead to an explanation of their habits.

It appears that herrings can sense differences in heat and cold as small as a quarter of a degree or less. They appreciate the fact that only a trace of an acid or alkali is present in water. So sensitive are herring to acids and alkalis that the scientists propose that these and other fish be used to detect the chemicals instead of the litmus paper, which chemists use, and in the same manner that canary birds are used to discover traces of poison coal gas in mines and elsewhere.

In connection with the entrance of salmon into rivers and other bodies of water, Drs. Shelford and Powers say it is evident that they find their way by virtue of the presence or absence of acids and alkalis.

Fish determine the direction they must go to fresh water even when hundreds of miles out at sea and find their way to bays, harbors, and inlets when their mating season demands it, by the chemical conditions of the water. It is not necessary to appeal to "instinct" to explain the return of certain salmon to certain rivers or the running of herrings in certain localities. These new chemical discoveries make it all clear that smell and touch are the senses most concerned, and these are highly developed in certain species.

A carload of scrap tin which is detinned at the mill and afterward melted and sold as steel

A Carload Featherbed of Scrap Tin

THE two men in the picture are not reposing on a carload of hay, or excelsior or shavings. They are taking a noon day siesta on scrap-tin loaded at one of the big sardine-canning factories at Eastport, Maine. Tin cans are not composed entirely of tin; they are cut from giant slabs of sheet steel covered with tin. After the cans have been cut from the metal the scrap is loaded into cars and delivered to a detinning factory where the tin is chemically removed from the sheet steel. The detinned scrap is sent to the steel mill where it is melted into steel billets.

Getting the Most Out of the Mining Mules

THE reputation of the mule is unenviable, to say the least, and to the unthinking there is no better way to make him work than by the unstinted use of the bale stick. In the mines, especially, where mules are used exclusively, humane methods of treatment are generally considered impracticable. The little animals are usually at the mercy of brutal and ignorant drivers and are often forced to work from morning until night without food or drink during the day.

But scientific thought is reaching even the mining mule, and progressive firms are arriving at the conclusion that inhuman abuse and negligence which result in disability or death are not in accordance with sound business methods and common sense.

The mules represent an average expenditure of about one hundred and fifty dollars each. Consideration for their comfort and health is simply a conservation of capital, according to the more modern viewpoint. An employee who is caught abusing or maltreating one of the animals of a certain western mine, for instance, is instantly dismissed on the theory that if he does it once he will very probably do it again and again.

Bungalow Fire Stations Are Popular in Residential Sections

IN residential sections the old type fire station is a blot on the landscape and a cause of annoyance to home-owners, to say nothing of the scant comfort it affords the firemen. Modern progressive cities are favoring buildings which conform with the character of the neighborhood where the fire station is located. In business sections brick and stone are used, and the buildings are as nearly like the average type of the locality as possible. In the residential districts the bungalow type is favored.

The illustration shows a station of this style in Portland, Ore., which might easily be mistaken for a picturesque residence if it were not for the inconspicuous sign above the entrance. The firemen do their own housekeeping, and there are no curtains in the neighborhood more immaculate, no windowpanes more glistening or grounds more neatly kept.

A fire station in Portland, Ore., which vies with any house in the neighborhood for attractiveness of design

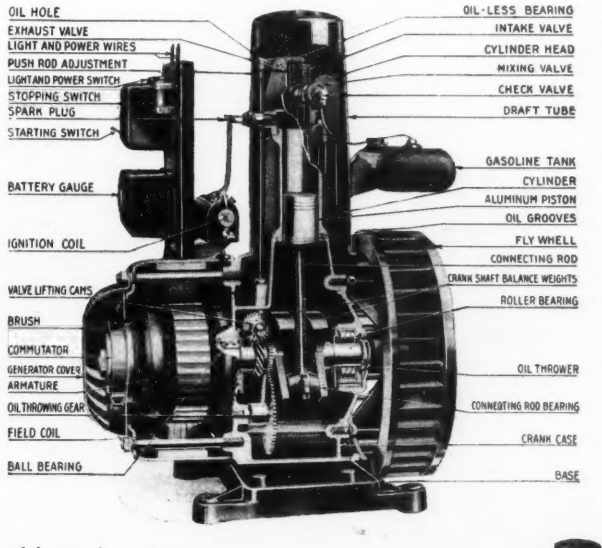
A Miniature Power-Plant for the Home

All the essential elements of a great commercial supply plant are incorporated in simplified form

A COMPLETE power-plant supplying a home with all the electricity it needs is in reality a miniature power-house like that used to supply electricity to thousands of homes. It must contain all the essential elements of such a power-house but on a smaller and simplified scale.

Still, a gasoline-engine and a dynamo are not simple things. Formerly, only a skilled electrician and mechanic was able to run his own plant without trouble. With the further development of the individual electric-plant, however, it has finally been made practically automatic in operation and so simple that a child can operate it.

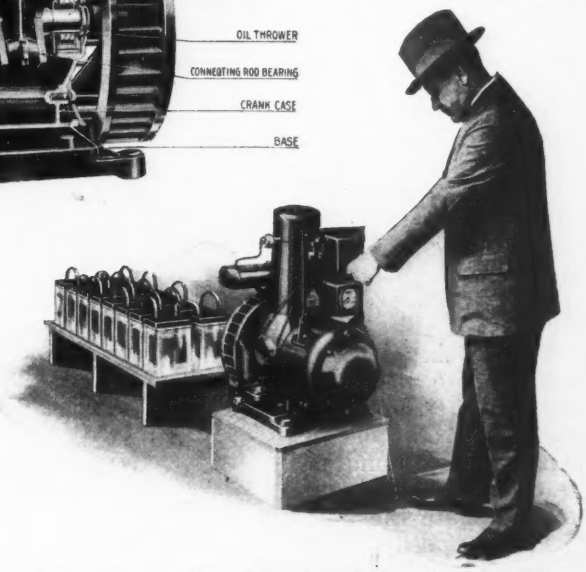
One of the first things simplified was the gas-engine. It is now automatically oiled. Because it has a self-starter, it is started by the mere closing of a switch. The next improvement was the combining of the engine and dynamo into one apparatus. Formerly they were separate machines connected by a long belt. Now they are mounted on the same shaft. Lastly storage-batteries are now used, which not only enable a man to run his engine-dynamo set during the odd times he is at leisure, but have greatly reduced the cost of producing the electricity.



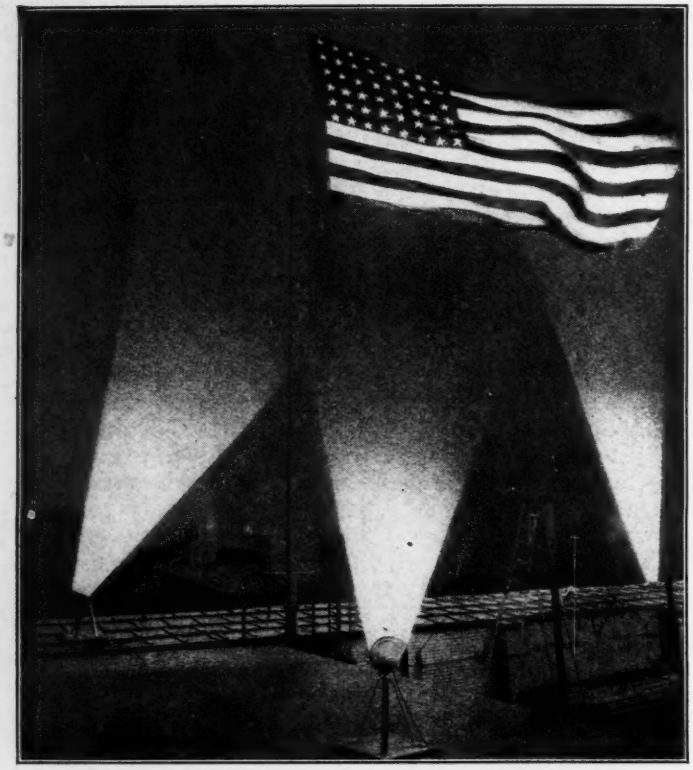
The storage-batteries serve the purpose of storing the electricity until the time when it will be wanted, in much the same way as a reservoir stores water. After they have been filled, the batteries will hold enough electricity to last for four or five days of service. When they are empty, it is necessary only to start up the engine and dynamo again. The engine drives the dynamo and when it revolves, just as when the great dynamos of a large power-house revolve, electricity is produced. The dynamo then feeds the electricity into the storage-batteries to be again stored until wanted. It has been made easy to tell when the batteries are empty; for at such a time an instrument on the switch-board which is mounted on the top of the dynamo, points to the word "empty."

When running normally, the plant can light fifteen sixteen-candlepower lamps, or it can run two small motors of one-sixth horsepower each. It can do this continuously for eight hours. If it is desired to use them longer, it is necessary only to close the switch of the self-starter of the engine-dynamo set. The plant can also be used to light thirty-two lamps, or fifteen lamps and two motors, by starting up the engine-dynamo set and running it continuously.

The cost of gasoline for the engine is only twenty-five cents a day. When natural-gas can be used in the engine, this cost is still further reduced to eight cents a day.



Above: Cross-section of the simplified engine-dynamo set. Below: The set complete, with the batteries

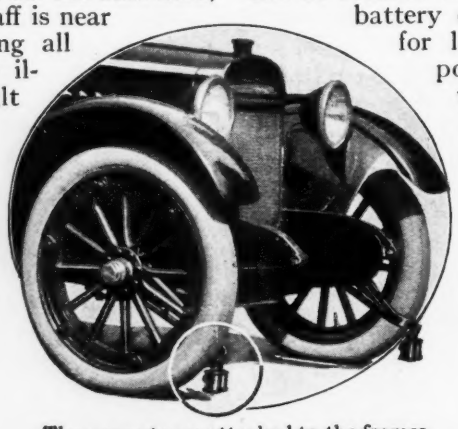


The flag is kept constantly illuminated at night, despite the shifting of the winds and other difficulties

Illuminating the American Flag—A Problem for Patriots

ONE of the striking scenes on the streets in Chicago is a large American flag brilliantly illuminated flying from the flagpole on the top of one of the down town skyscrapers. The flag is thirty feet long and fifteen feet wide. The shifting of the direction of the wind, the greater amount of light required for the blue field, and the fact that the staff is near the edge of the building all combined to make the illumination a very difficult matter.

To overcome defects due to the shifting of the wind six powerful lamps were installed, only four being used at one time. Two of the lamps are five hundred watts; these are used to illuminate the blue field on opposite sides. They are provided with projectors, and may be moved to the best positions to light up the blue field, depending upon the wind direction. The other four are two hundred and fifty watt lamps. A man is detailed to adjust the lamps so as to secure just the right illumination regardless of wind direction.



The magnets are attached to the frames of the wheels to protect the tires from tacks and bits of steel on the road

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Picking Up Tacks in Front of Your Automobile

AN ingenious device consisting of a magnet carried in front of each of the two forward wheels of an automobile and in close proximity to the ground, has just been invented. It will prevent the puncturing of pneumatic tires by automatically picking up magnetic particles such as chips of metal, tacks, nails, and the like.

The magnet is pivoted to the front end of an extending arm attached to the front axle wheel spindle, so that it will swing with the wheel during steering and always remain in front of it.

As shown in the accompanying drawing, a guide roller is provided at the rear of the magnet casing for the purpose of preventing the magnet from interfering with the tire and injuring it when it is swung backward about its pivot as when passing over extraordinary projecting obstacles in the road.

The current for magnetizing the magnet can be secured from the magneto, storage-battery or generator on the car for lighting or ignition purposes. The connecting wires are carried in one arm of the extending bracket which is made hollow for the purpose.

Now should any tacks get squarely in the way, as they usually do when the automobile is nearing the speed limit, the magnets will immediately lure them to one side and pick them up, deferring indefinitely the time of the inevitable blowout.

A Mechanical Telephone Operator

It will take down the number of a call or a message when you are out

LOST calls over the telephone will be a matter of history with the anticipated adoption of a device recently invented by Charles E. Bedeaux, an efficiency engineer at Grand Rapids, Michigan.

The device is simple. It merely gives a secondary function to the clapper of the bell. It is fastened to the battery bell box and consists of a steel platform twelve inches in length, supporting a clock train, which operates a celluloid-covered cylinder by means of a spiral shaft. A large cogwheel at one end of the cylinder transmits the energy from the works. On this celluloid rests a nicely balanced pencil which is connected by a steel wire with a pinion suspended in jewelled sockets at either side of a metal bridge, extending from the battery box. The pinion, in turn, is connected with the clapper by means of a steel fork. The arrangement has been so well-figured that the maximum amount of vibration is secured on the pencil with the minimum amount of pressure on the clapper. As the bell rings the message is immediately inscribed on the celluloid.

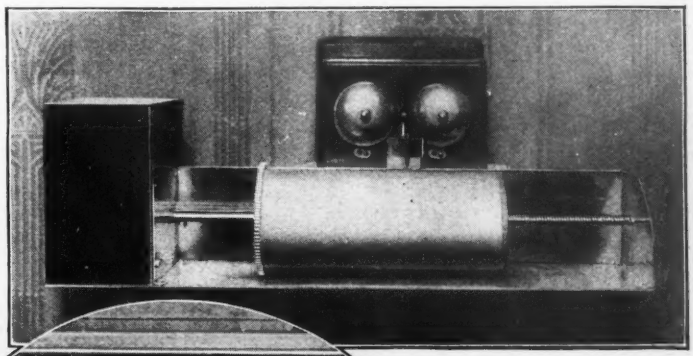
In order to use the device the following code must be carried out:

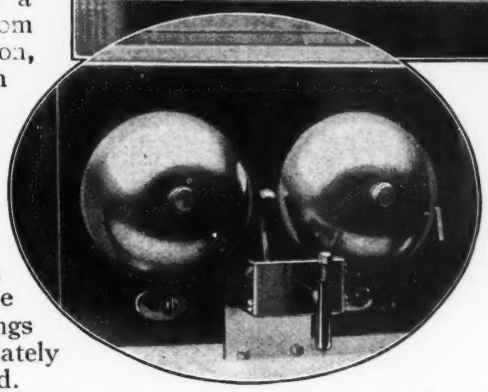
Number	Rings	Number	Rings
1	1 short	2	1 long
3	1 short 1 long	4	1 long 1 short
5	2 short	6	2 long
7	2 short 1 long	8	1 long 2 short
9	1 short 1 long	0	2 long 1 short

As an example of the operation:

Jones calls Smith and discovers that Smith is absent. Jones immediately hangs up his receiver and then opens the line ringing back his own number. If it is 2345, he rings 1 long, 1 short 1 long, 1 long 1 short, and 2 short. These marks are inscribed on the cylinder and are readily discernible to Smith when he returns.

The device may be shut off by means of a clutch or it will run for a period of forty-eight hours. It is absolute in its operation and registers the codes distinctly. Patents cover a later addition of a ribbon over the cylinder which will record the hour and approximate minute that the call is made. Other features also cover the possibility of operating the device in a room far from the battery box by means of electrical connections.





Above: On this celluloid-covered cylinder a pencil rests which is connected with the battery. It inscribes the message

At left: The maximum amount of vibration is secured on the pencil when the minimum amount of pressure is exerted on the clapper

What One Penny Will Buy in Electrical Service

WITH the cost of living skyrocketing it is comforting to reflect upon the great purchasing power of just one cent in electricity.

On the basis of eight cents per kilowatt-hour one cent will buy electric service to light a twenty-five watt lamp for five hours, to make ten cups of coffee in an electric coffee pot; to heat milk in a nursery milk-warmer three times; to sew three hundred thousand stitches on a motor-driven sewing-machine and to boil twelve eggs in an electric hot-water cup.

Electricity is now regarded as the cheapest heating, lighting and cooking means on the market, the cost of installation being the chief expense.

Building a Ship Like Caesar's

A Californian will make a cruise around the world in a Roman galley which he built himself

A QUAINT, staunch little craft, built along the lines of the ancient Roman galleys, lately startled the inhabitants of the university city of Berkeley, California, by navigating through the residence and business streets in a land voyage of two and one-half miles to the ocean shore, where it was to receive its finishing touches.

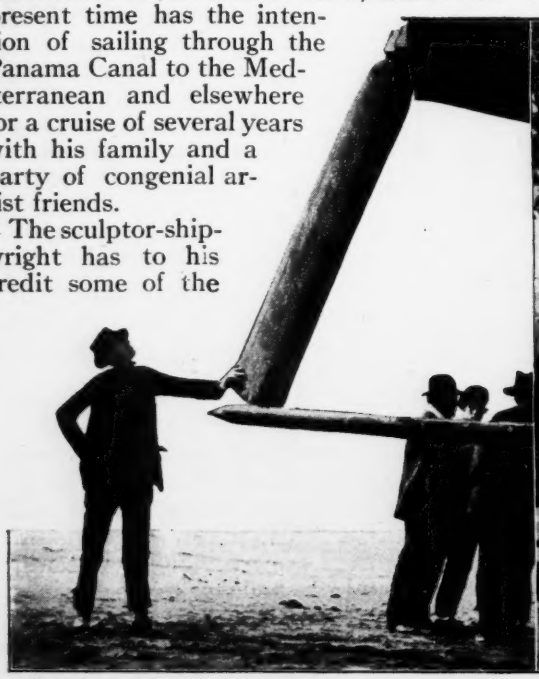
The builder and navigator, Mr. Robert Paine, had the strange craft moved to the beach on three-wheeled house-moving trucks, the tow being successfully accomplished in a few hours by a motor truck.

The idea of constructing such a craft was conceived and begun just before the European war broke out, the builder, a sculptor of note, having a commission to execute in Spain. When his original plans were thwarted, he altered them, and at the present time has the intention of sailing through the Panama Canal to the Mediterranean and elsewhere for a cruise of several years with his family and a party of congenial artist friends.

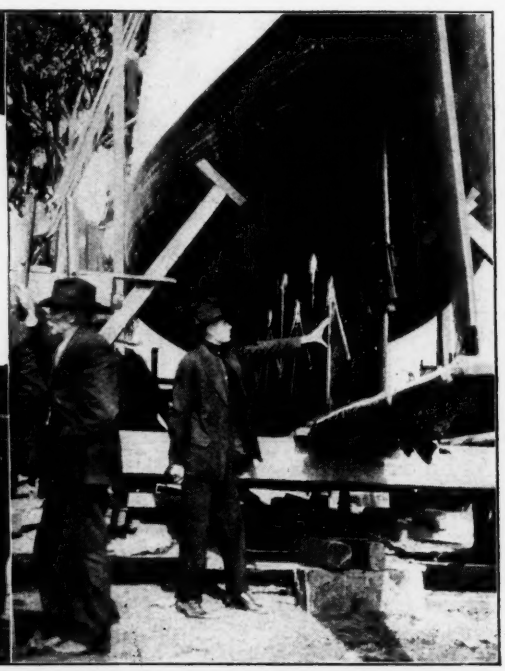
The sculptor-shipwright has to his credit some of the notable statuary of the Panama-Pacific Exposition. The strange craft, which is about the size of the smaller of Columbus' caravels, 55 feet in length, 20 feet high, and 11 feet of beam, was hewn out of the rough by his own hands "between times." It will be rigged with a large square sail.

Mr. Robert Paine, the builder at work on the rudder boxing

The vessel has been given the name of Aries, the name having been taken from one of the signs of the Zodiac. A large ram's head carved from wood serves as a figurehead. A most conspicuous and debateable feature of the outward appearance is the queer oar-like rudder protruding from the stern, like an ancient galley oar, but rigidly pivoted at the center of its lower end in a ball-and-socket joint. A tiller arm is attached to the rudder head located in the peep-cabin. Most rudders are



Side view of the rudder showing the queer manner in which it is suspended

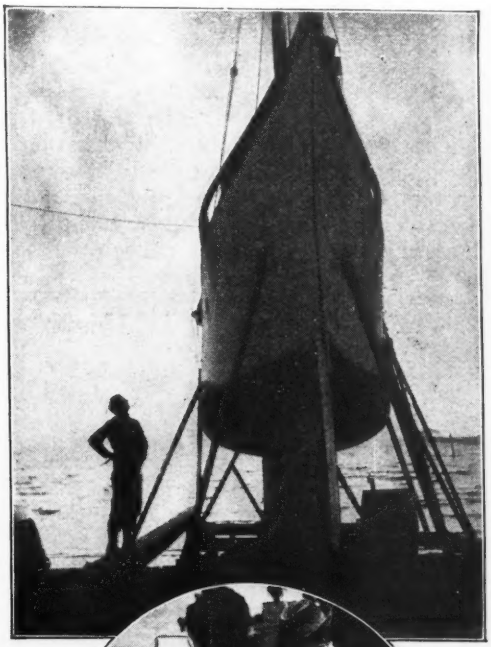


Stern view of the keel showing also the knife-edge of the rudder and brace beams

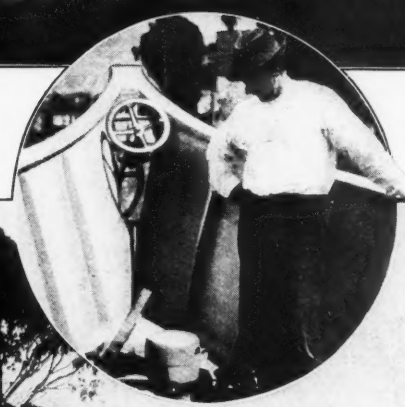
hung so as to swing hinge-like on one edge. This one, however, presents as much inclined surface to the water on one side of a vertical plane passing lengthwise through the center of the ship as on the other side. The queer rudder, the high poop, and the square-sail are the most curious and speculated upon parts of the craft, though the keel is of great interest.

After arrival at the seaside the completion of the square-sail rigging, the installation of a sixty-horsepower auxiliary gas-engine, a propeller, and tanks for upward of two thousand gallons of gasoline, and the encasing and ballasting of the odd cigar-shaped keel with reinforced concrete to a total weight of eighteen tons, were begun. The mast will rise thirty feet. There are two decks, the engine room being located in the keel.

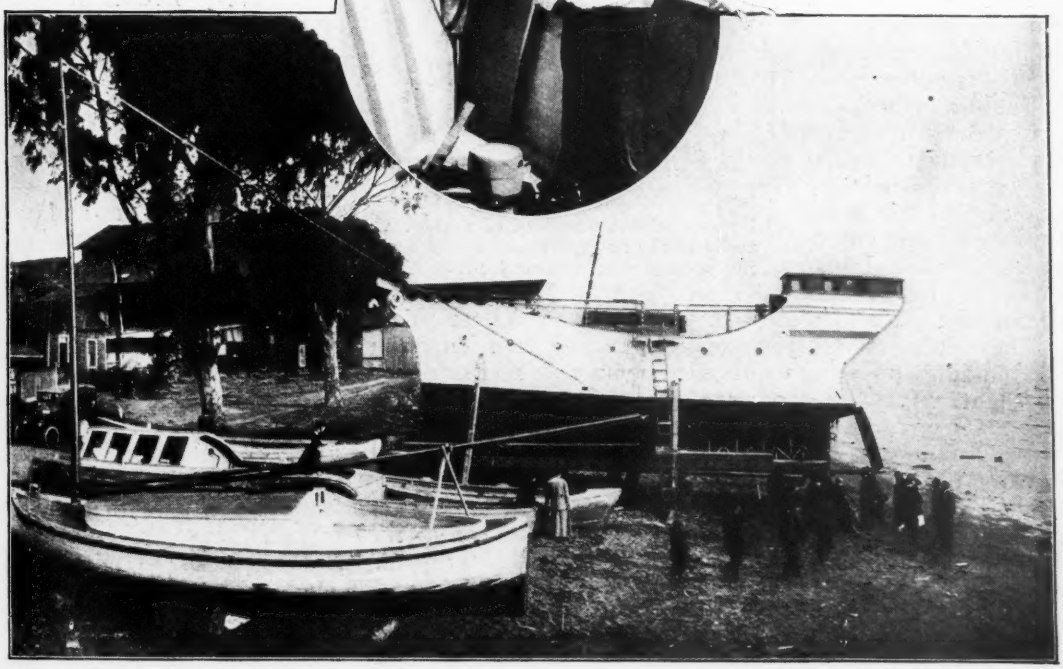
The razor-edged prow of a clipper ship graces the front end of the vessel. The beam at the waterline is fat and bulging, and the poop is high for sake of safety, observation and form. When the tiller arm is not in use, it is straightened out to become a companion-ladder to the top deck or poop through a hatch. An automobile steering-wheel with wire cables attached and leading back to the rudder is located forward in the very peak of the prow.



Above: A bow-on view of the galley, showing the height of the vessel and the rudder



At left: The auxiliary automobile steering wheel located in the peak of the prow



Side view of the "Aries" on Berkeley Beach, receiving the finishing touches. The builder himself is puzzled as to how he will get the craft from here into deep water, more than a mile away

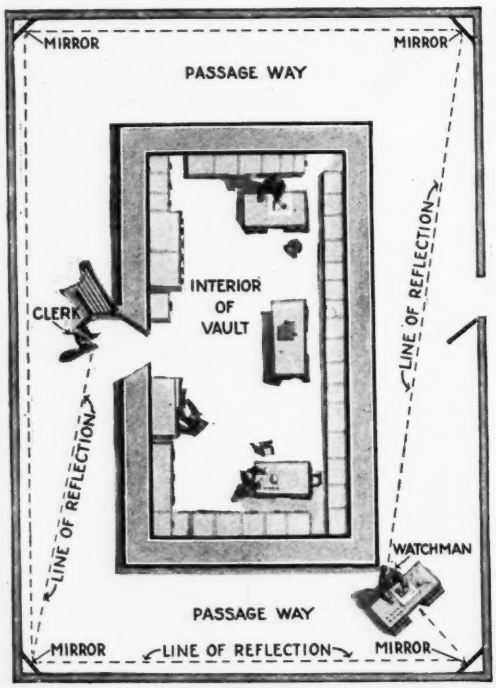
Safeguarding the Nation's Money

The Bureau of Engraving maintains a small arsenal, constant vigilance and the finest signaling system in the world

THE Bureau of Engraving and Printing, at Washington, D. C., where all paper money, postage and revenue stamps and valuable documents are printed, is one of the most carefully guarded buildings in the world. It is protected by some of the most modern electrical burglar-alarms, and sixty armed night watchmen patrol the plant.

Five different signaling systems are installed in the building, including the watchman's time recorder, the electric clock system, the division report system, fire alarm system, and the messenger call system.

Not only are watchmen on duty at night, but during every hour of the day as well. The vaults are said to be among the finest in the world. There are four major vaults, all built alike, and a number of smaller ones. These vaults are guarded by a special force of men, headed by the custodian of the vault. No one is allowed near the vaults unless on official business or by special permission of the Director of the Bureau.



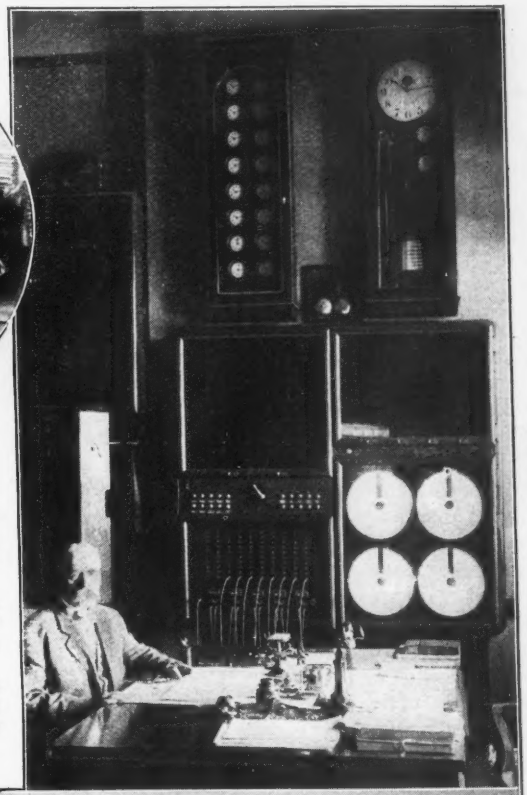
By an elaborate system of mirrors the interior of the vaults as well as the surrounding passages are kept under constant watch

The vaults themselves, separated from the building, are really vaults within vaults. At night, when the doors are closed, two watchmen go completely around them every fifteen minutes. By an elaborate series of mirrors, a watchman can, in walking over the grating, see entirely under as well as on top of each vault; and if he stands at a certain given point he can see all around the vault as well. The vaults themselves are forty by eighty feet, and some twenty feet high. They are built of concrete, about four feet thick, and are reinforced with steel railroad-ties. The concrete is intermeshed with burglar wires, so that a knife blade cannot penetrate at any place in the entire structure without sounding an automatic alarm in the office of the captain of the watch. The door itself weighs twenty-five tons, yet it is so perfectly balanced that it can be easily closed with one finger.

Because of the great size of this building and the nature of the work carried on, it is imperative that a most complete system be installed to allow the captain of the watch, who is in charge of all the watchmen, to know at all times just where each watchman is and also to be able to communicate with him in case of emergency. In the regular operation of the system the watchman turns in a signal from each station every five minutes during the night. This signal is received in the office of the captain of the watch in three ways: by the ringing of a bell, by the falling of an annunciator drop and by the perforation of a watch-clock dial. Should the watchman fail to ring in on schedule time from any station, the captain of the watch can immediately start an investigation.

The system is so laid out that it is impossible for a watchman to ring in on any but the right station at the right time without being detected. Each station is so arranged, that, should the watchman wish to communicate with the captain he can telephone in. On the other hand, when the captain wants one of the watchmen, he shifts a lever, whereupon a horn blows, each man having a certain signal. By means of code signaling this system gives the general alarm to all the watchmen at night.

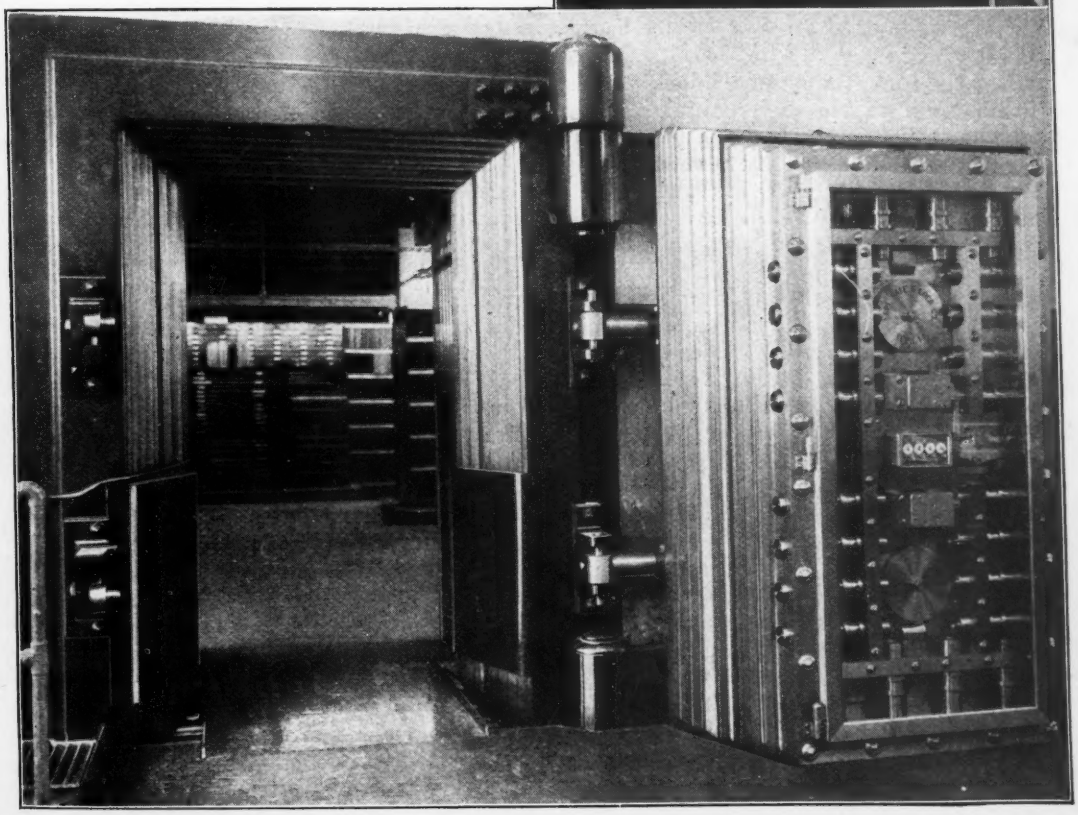
Where Thieves Can Not Break Through and Steal



Above: The material handled by the clerks of the Bureau is of enormous value, including finished paper money, stamps and invaluable plates and dies

At right: The Captain of the Watch in his office, where a small arsenal is maintained. Regular army rifles and revolvers are furnished for the watchmen

Below: One of the four major vaults, the door of which weighs twenty-five tons, yet is so perfectly balanced that it can be closed with a movement of the finger

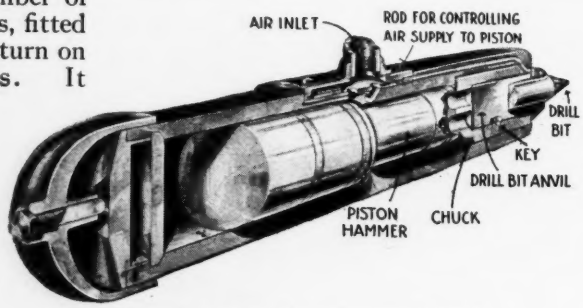


A Mechanical Rock-Worm

This apparatus gnaws its way through solid rock, using neither drill nor dynamite

FOR the past fifteen years inventors have been developing a rock-tunneling machine that could bore its way through hard rock more quickly, cheaply and safely than the rock drill and dynamite. At the present time one of these machines, developed by Oliver O. App, is demonstrating its possibilities in the subway excavation under the Grand Central Terminal, in New York city.

It is designed to cut away the rock by the action of a number of pneumatic hammers, fitted with chisels, which turn on a longitudinal axis. It represents a distinct improvement over former apparatus of its kind in the character of the cutting and the action of the hammers. When a chisel is not bearing against the rock, the hammer does not act. But as soon as the tool contacts firmly with the rock face the hammer operates.



Detail showing the component parts of the hammer and chisel element

The harder the rock the more air is supplied automatically. If the rock is soft, less air is applied; if sufficiently soft, the hammer is inactive, and the rock or dirt is cleaved off by the rotation of the tool. In short, the blow delivered is proportional to the hardness of the rock to be cut.

Until this cooperation between chisel and hammer was obtained, the tunneling machine was not a success. Even in its present stage of development it is doubtful if it represents an improvement over the rock drill and blast method. In tunneling through soft rock and dirt it is, obviously, a great improvement over all existing apparatus. But when it is working in hard New York gneiss, for instance, the spokesmen for the rock drill and blast method say their way is safer and cheaper. In three eight-hour shifts in which the total operating time was thirteen hours, the machine made an advance of nearly nine feet. The pneumatic rock drill has better records than that to its credit. It remains for the future to determine whether or not the machine will supersede the rock drill.

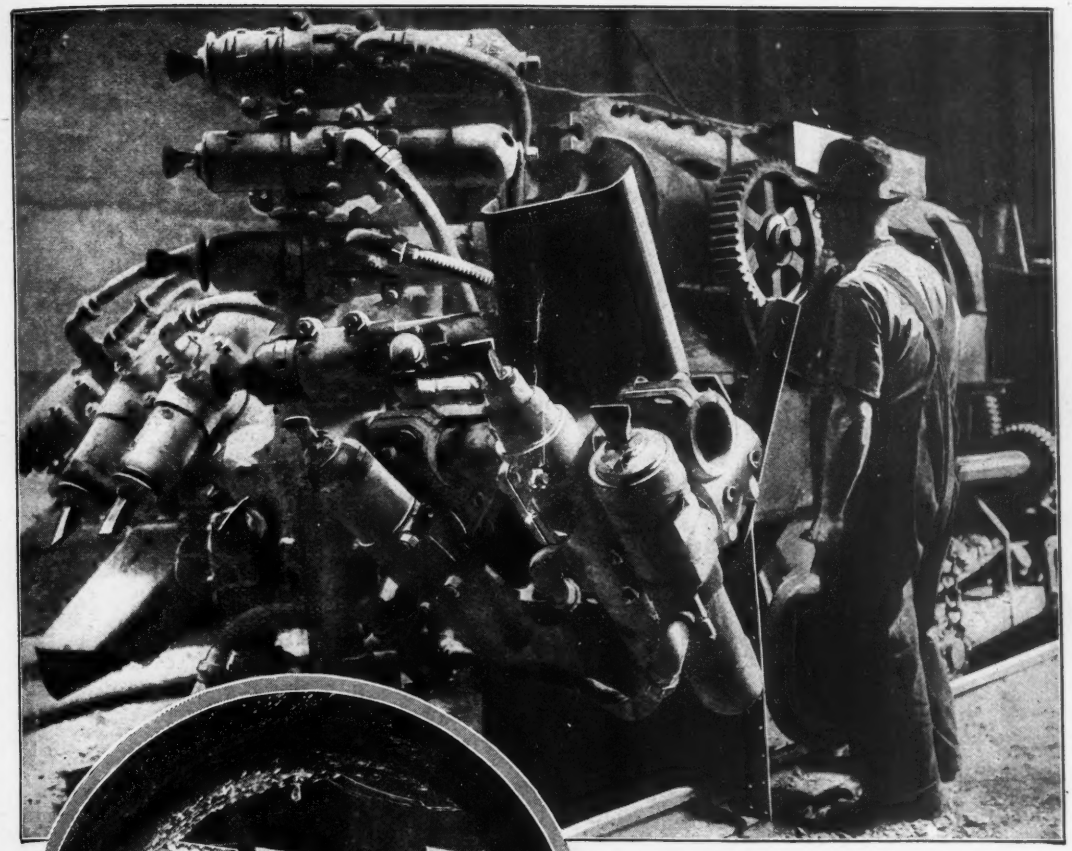
The carriage of the machine consists of a two-wheel main truck at the rear and a two-wheel guide truck at the front. The wheels rest on a light track of standard gage. The front and rear halves are separate. The front, carrying the revolving head, is moved forward one inch per revolution, by means of two lead-screws. After the front has advanced two or three feet the rear is moved up by means of gearing.

The head, which supports the tool carrier, consists of a hub and four arms placed ninety degrees apart. Two arms carry four hammers each; on each of the other two arms are three hammers. These fourteen hammers are so arranged that the chisels cut in concentric circles.

The power to operate the machine is furnished by a compressed-air engine located on the forward part of the carriage. A spray of air and water falls over the face of the rock to lay the dust. The broken rock is delivered on a belt conveyer that discharges into muck cars at the rear.

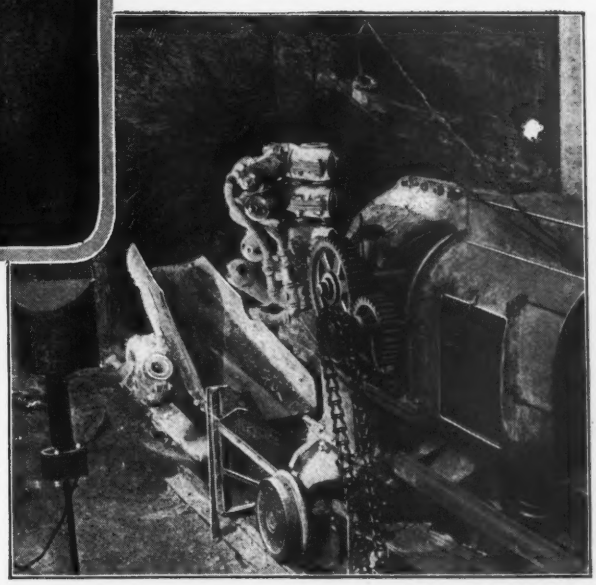
The hammer and chisel element, which is illustrated herewith, is a new design. In one of the old rock-cutting machines a three-inch cylinder, with piston, valves, and springs at each end of the cylinder, was tried. In the present machine a four-inch valveless cylinder carrying a thirty-two-pound hammer twelve inches long is used. The hammer is reciprocated by the action of compressed air, the distribution of which is effected entirely by the passing of the hammer over ports in the cylinder wall, there being no distributing valves whatever. The hammer strikes a steel chisel-holder, into which the chisel is firmly inserted. Oil for lubrication enters the cylinders with the air.

The New Tunneling Machine

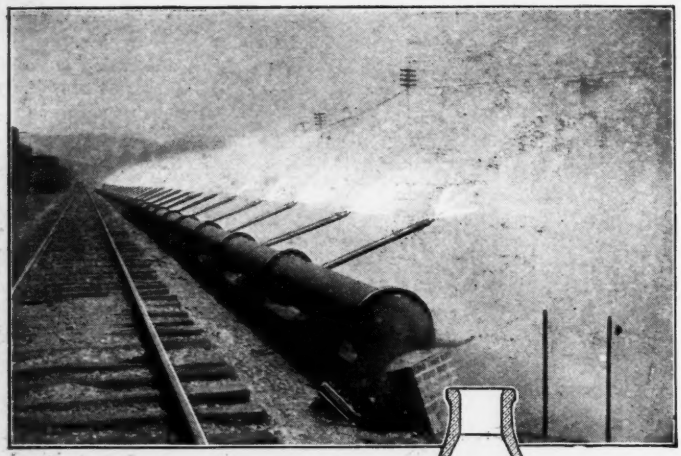


The apparatus assembled. There are fourteen hammers in all, each capable of drilling one-half inch at a stroke. A compressed air engine supplies the operating power and is the mechanical brain as well as the muscle of the device

Above: The fourteen hammers are arranged on a longitudinal axis and are fitted with chisels which cut into the solid rock in great concentric circles



The carriage of the machine consists of a two-wheel main truck at the rear and a guide truck at the front. The wheels rest on a light track of standard gage



The water is shot out from the nozzles at the rate of one thousand gallons a minute

Cooling Off a River with Its Own Water

THE large manufacturing plants of the Westinghouse Company in Pennsylvania require a whole river of cool water to run them efficiently. The water is needed to condense the steam which has been used to drive the steam-engines. After serving this purpose in the first few plants, the water becomes hot, and unless it is artificially cooled, it is unfit for further use. In the summer, the temperature of the river often reaches nearly a hundred degrees.

By artificially cooling the river, thousands of dollars have been saved because of the increased efficiency of the steam-engines. To cool it off, the river's own water is used as it emerges from the discharge-tunnels of the plants. The hot water from the tunnels is forced by two huge centrifugal pumps into a battery of forty-five large nozzles. These are stretched along a large cast-iron pipe, six hundred feet long, and a continuous spray is formed which reaches far out into the river. Each spray is directed against another, and the collision breaks up the sprays into particles microscopically small but millions in number which of course, quickly cool as they travel through the air. When they finally fall and mingle again the whole river is cooled more than twenty degrees.

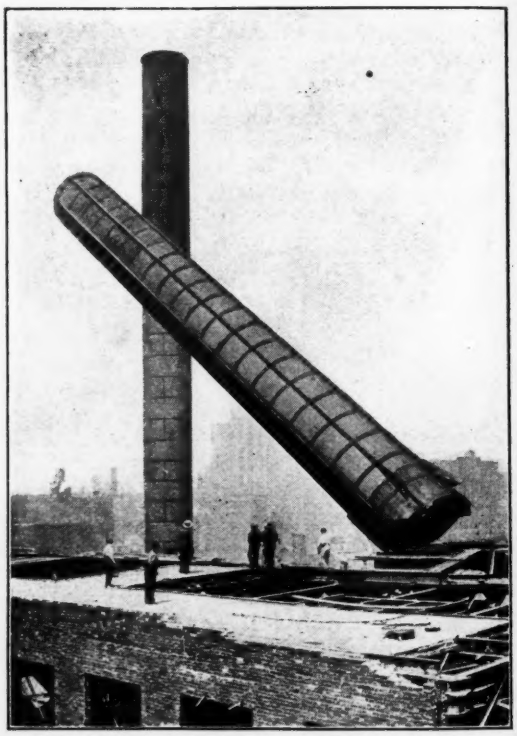
Such a spray is a rare spectacle when the sun shines on it. The particles of water shot out from the nozzle at the rate of one thousand gallons a minute form a continuous rainbow.

Felling a Stack of Steel by Means of a Flame

THE felling of this great steel stack below was accomplished by means of a single oxy-acetylene cutting-torch.

Acetylene-gas was stored under great pressure in a steel tank and as it slowly issued from the tank into the torch it was ignited. As the acetylene burned in the air a great amount of heat was developed; but when oxygen was turned on from another tank, the heat then developed was many times greater. In fact, so hot was the small flame that it bit into the solid metal as if it had been so much putty. The places that were cut being carefully selected near the bottom of the stack, the huge column of steel was made to fall in a predetermined spot.

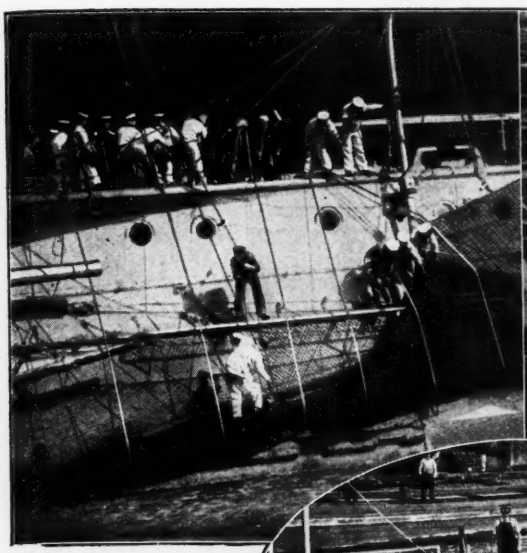
The stack was on the old Harrison Street station of the Commonwealth Edison Company, in Chicago, now being dismantled to make way for a new sixty million dollar terminal.



This huge steel stack was felled in a few minutes by the flame of an oxy-acetylene torch

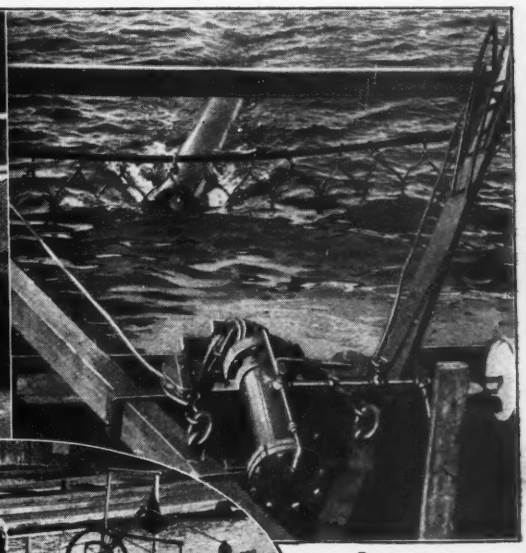
Protecting a Battleship Against Torpedoes

A new application of the net which may popularize its use



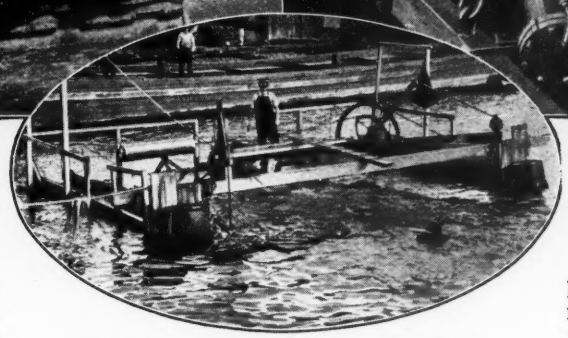
© Paul Thompson

Above: Setting a torpedo net around a British dreadnought. The net is held out about thirty feet



Photos © Int. Film Serv.

The torpedo at the instant of contact with the "catcher." The net is connected with a shock absorber



Testing a new torpedo "catcher" at the Naval Topedo Station at Newport

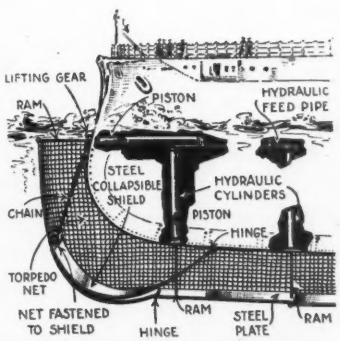
THE protection of a battleship against its pigmy but deadly assailant, the torpedo, is a problem which inventors have yet to solve. In the British Navy some reliance has been placed on nets held out as a sort of shield around the ship, but the results have been unsatisfactory. The booms which held the nets out have been large and unwieldly and have been fixed in such a way that the shock of a discharge was certain to unship them. Furthermore, it was impossible to use them once the ship was under way. As may be expected the handling and fixing of a net, even during fine weather, is no easy task.

Great Britain is the only power which has put the torpedo net to an exhaustive test. Our Navy has never required them.

The accompanying photographs show a new torpedo "catcher" (the inventor's word for net) which its sponsor thinks is strong enough to protect a ship from torpedo attack. It consists of half-inch wire cables in net form on an L-shaped sliding steel frame. It is hung about twenty-five feet from the ship's side.

The net defense of a ship is always divided into three different parts, namely, the main defense, bow defense, and stern defense. The main defense covers the middle and most vital parts of the vessel—that is to say, the engines and magazines, and the bow and stern defenses cover the other parts of the ship. These latter, however, are used only when the ship is at anchor.

When in motion the water would force the net up toward the surface, leaving the hull of the ship exposed.



Details of the elaborate torpedo net operated by hydraulic cylinders. No booms are used

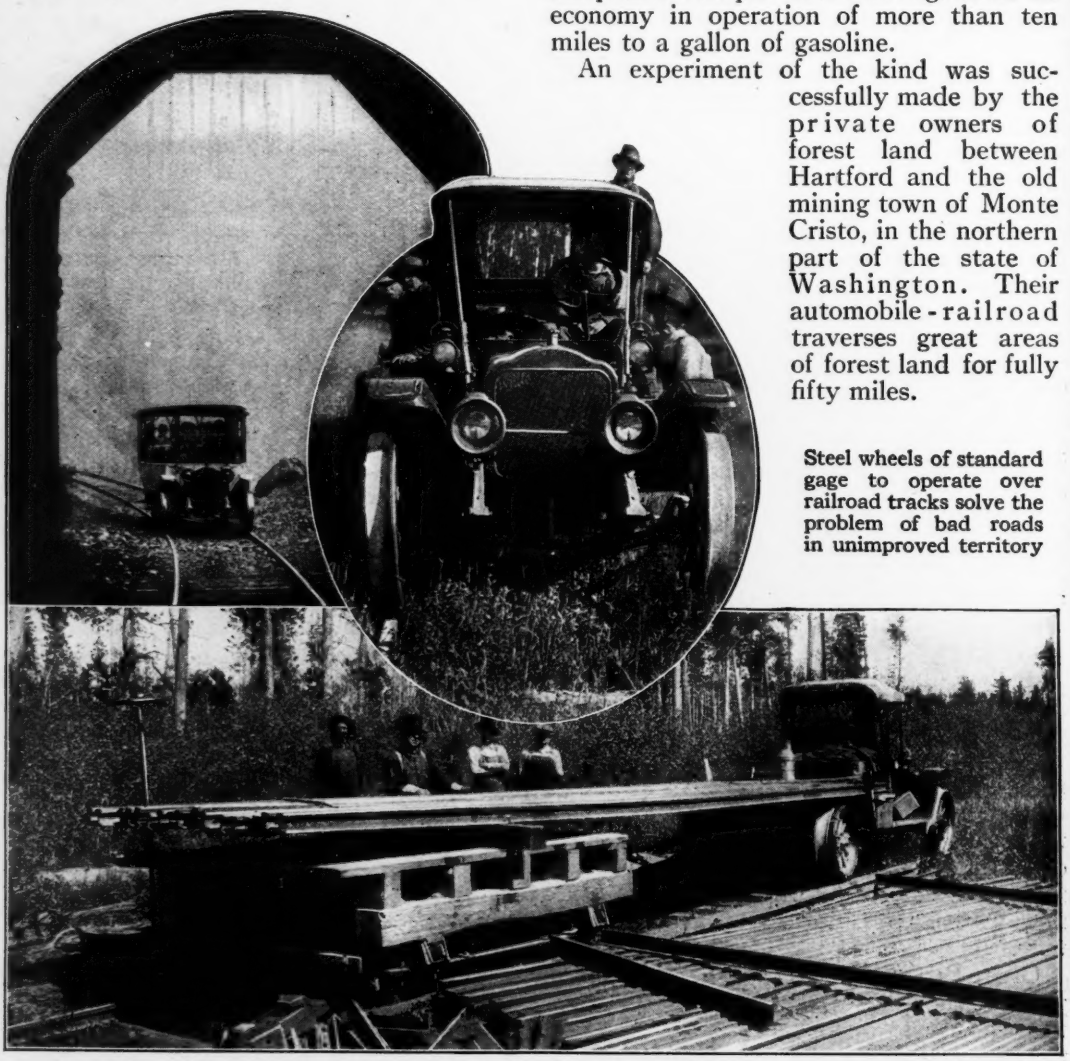
Putting Railroad Wheels on Automobiles

How the automobile "gets there" when roads are bad and the railroads are the only means of locomotion

OWING to the high price of steel, a railroad in Montana decided to salvage the rails of an abandoned lumber and tie road connecting the station of Nahant, Montana, with the great forests thirty-five miles to the west, now protected by the Forest Reserve Act. The transfer company, which handled the salvage work, found that the problem of power was the chief obstacle. The track was in poor condition. It could not stand the weight of a locomotive, without repairs, and in places it was almost hidden in brush.

A standard two-ton truck was purchased and equipped with a set of steel wheels with flanges for operating on rails, and then put to work. In the first month, the truck covered about three thousand three hundred miles. By the use of a flat car as a trailer, the truck was able to haul twelve tons of rails into Nahant each trip, making two a day. It climbed several grades as steep as seven per cent and registered an economy in operation of more than ten miles to a gallon of gasoline.

An experiment of the kind was successfully made by the private owners of forest land between Hartford and the old mining town of Monte Cristo, in the northern part of the state of Washington. Their automobile-railroad traverses great areas of forest land for fully fifty miles.



Steel wheels of standard gage to operate over railroad tracks solve the problem of bad roads in unimproved territory

In the first picture above the automobile passenger truck on railroad wheels is shown. The wheels are of the standard railroad-track gage

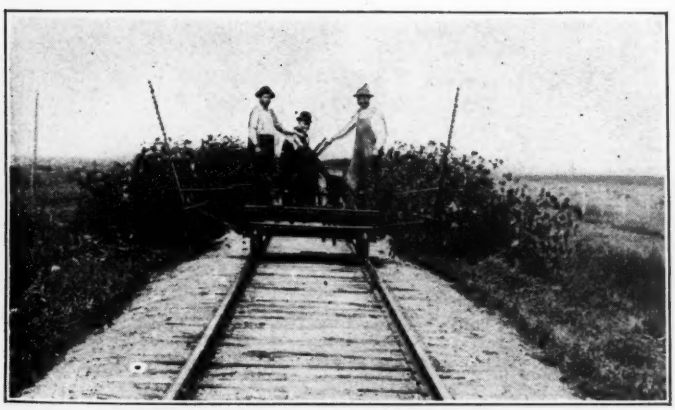
By the use of a flat car as a trailer the automobile truck was enabled to haul twelve tons of rails on one trip. It made two trips daily

A New Railway-Handcar Mowing-Machine

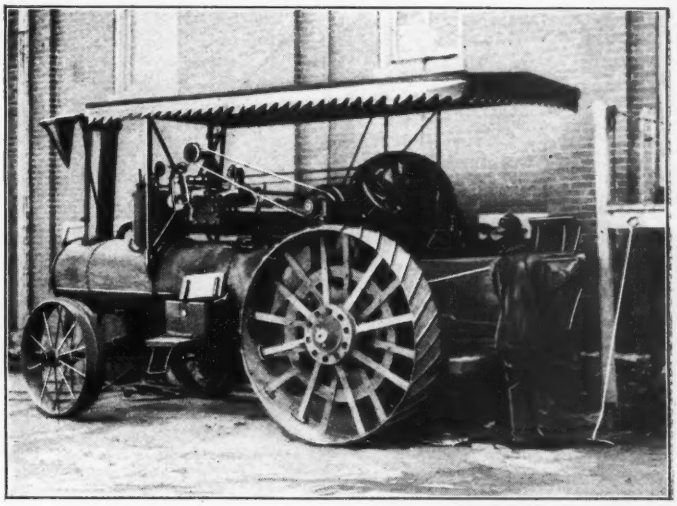
THE railway-handcar has been converted into a railway mowing-machine. The three men required to operate it are able to do the work of thirty men with scythes, and when the car is mowing at its maximum speed it can cut down from two to four miles of weeds and brush an hour. When the mowing blades are not in operation the car can travel from eighteen to twenty miles an hour. The motive power is a six-horsepower gasoline engine.

Thomas McGee, of Madison, South Dakota, is the inventor of the machine. He has made the mowing blades vertically adjustable, so that they may be moved into different positions and to different inclinations for mowing upon level or inclined surfaces. Furthermore, the mowing mechanism at each side of the car is controlled independently, so that one mower may be thrown out of operation while the other continues to cut.

The accompanying illustration shows the mowing-machine car with cutting blades raised to pass through center-guards. When the blades are operated they cut a swath five feet wide on each side of the car. After the weeds and brush have been removed another machine—the railway disking machine—is brought into operation in its wake. This machine has a series of disks which smooth down the gravel just beyond the ends of the ties.



The machine runs at from two to four miles an hour, cutting a five-foot swath on each side of the track with the blades



A supply pipe connected the boiler of the engine with the pipes of the heating plant and made a whole theater comfortable

A Steam Tractor Makes a Theater Audience Comfortable

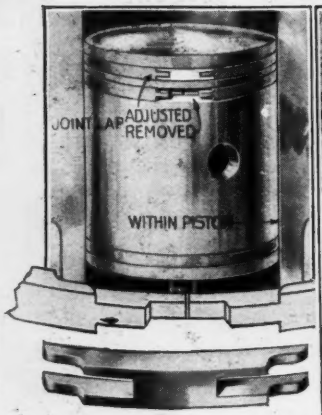
WHAT is the cheapest and most satisfactory method of heating an opera house when a new heating plant is being installed? This was the question put to the manager of the city opera house in Carlisle, Pennsylvania. A number of performances were scheduled, the weather was stormy and cold, and the theater interior had to be made comfortable for the audiences.

The manager looked about him for a means to heat his theater. Several methods were suggested, among them the utilization of a big steam tractor. This last appealed to him and he had the tractor run up an alley to the stage entrance. A supply pipe connected the boiler of the engine with the pipes of the heating plant of the theater, the pipe being run through a window in the rear of the stage, as shown in the accompanying illustration.

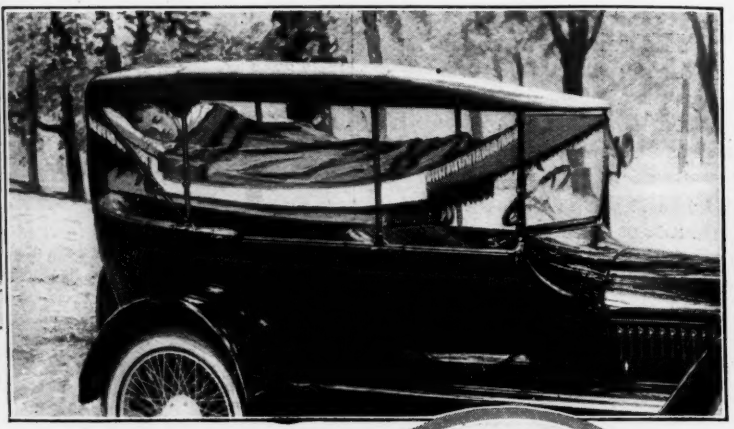
This arrangement proved satisfactory, causing the manager a minimum of expense and inconvenience.

It kept the heating plant working at its greatest capacity and no one except those who were acquainted with the facts realized that the steam tractor sheltered against the side of the building had any part to play in making the audience comfortable and the show successful.

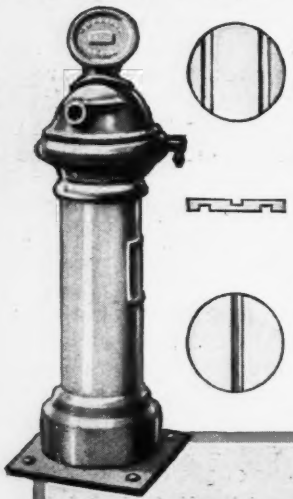
What's Next in Automobiles?



A gas-engine piston-ring. It prevents the breakage of the member ends and provides a metal-to-metal seal which prevents gases working past the piston

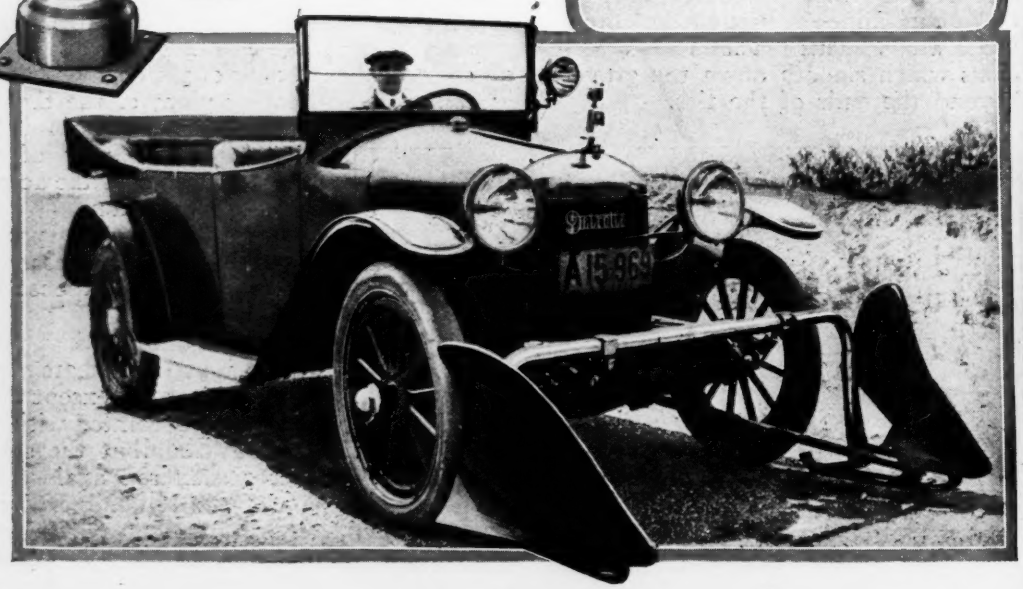


Above: Not merely a hammock but a warm, comfortable bed for automobile campers. The seat cushions placed lengthwise between the tops of the seats form the mattress

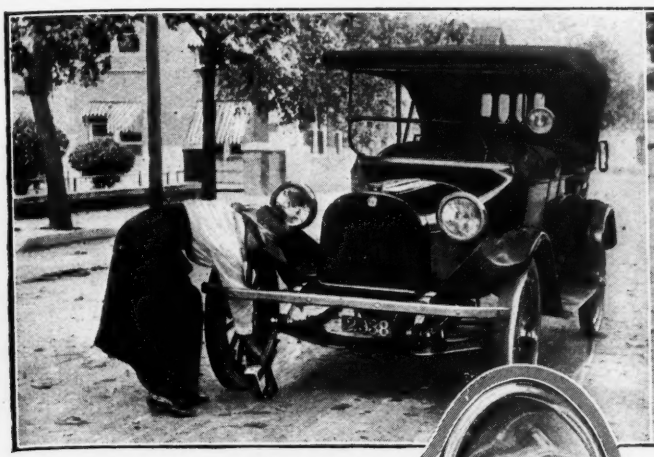


At left: A hydrant for motor-busses. Drivers are supplied with disks which, when slipped into the slot, permit the hose to be attached and water drawn off

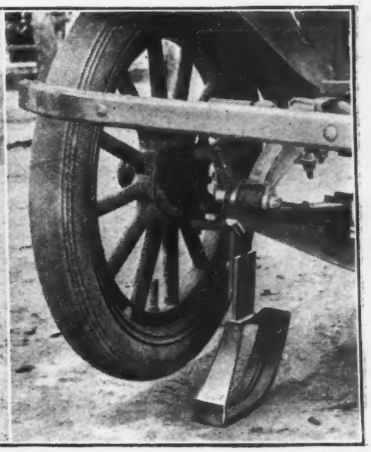
At right and below: A combination bumper and snow plow which enables automobiles to keep roads open in winter. Spiral springs allow for variation in the road surface. The plows are easily uncoupled from the bumper



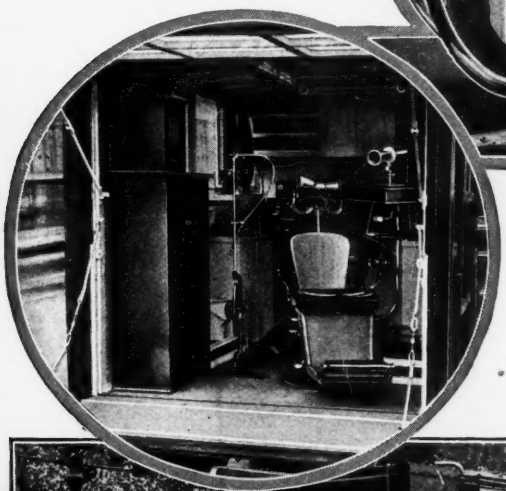
The Latest Automobile Improvements

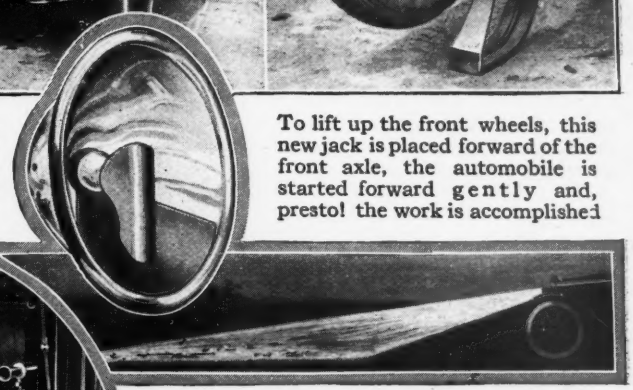


A new device which enables the automobile to jack itself up. It is easily adjusted. Rocking it back and forth elevates the axle higher and higher



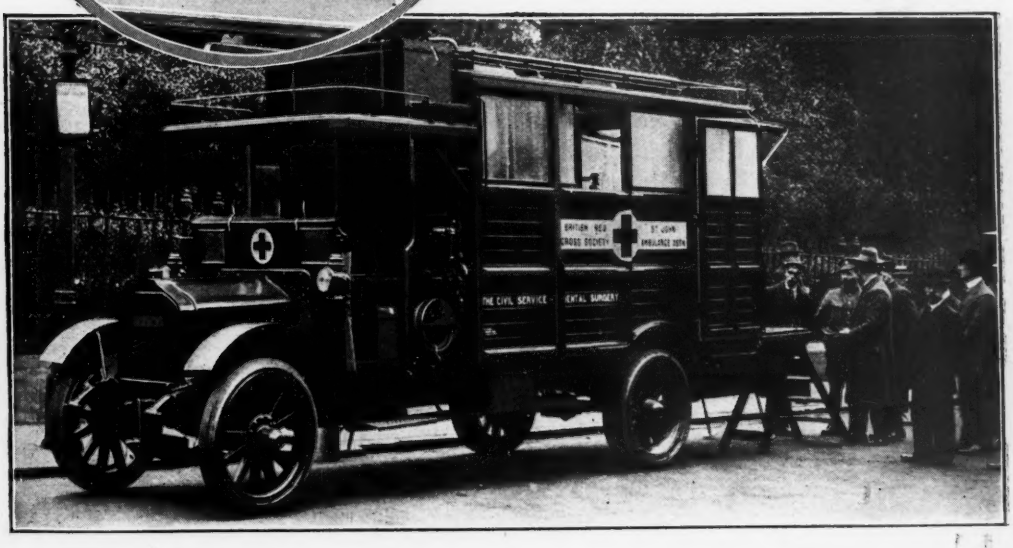
To lift up the front wheels, this new jack is placed forward of the front axle, the automobile is started forward gently and, presto! the work is accomplished

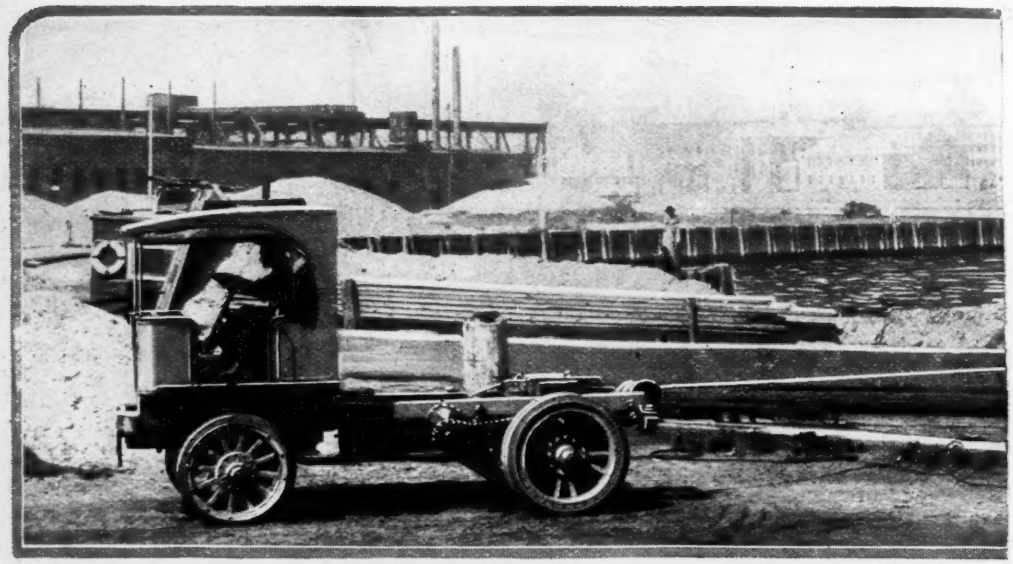




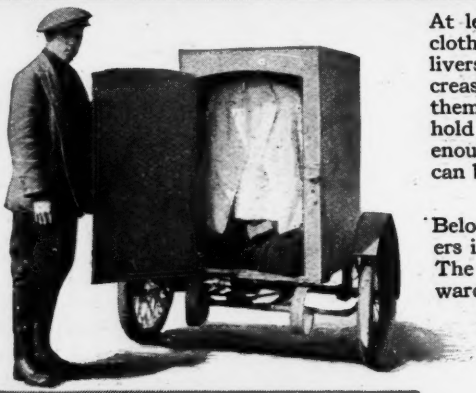
Above and in oval: A device which eliminates the glare of electric headlights by throwing the rays from the upper half of the lamp on the road. The rays of the lower half are directed so that they add to the light deflected from the upper half

At left and below: The first dental motor-car for the British troops. There are two chairs in the car and other equipment sufficient to treat four patients at once





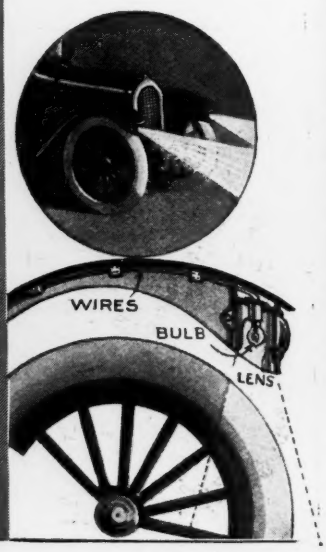
While its two-wheeled trailer was being loaded with sand from an overhead hopper, the truck shown above saved tugboat hire by hooking to a loaded scow and pulling it along to the dock where it had to be unloaded



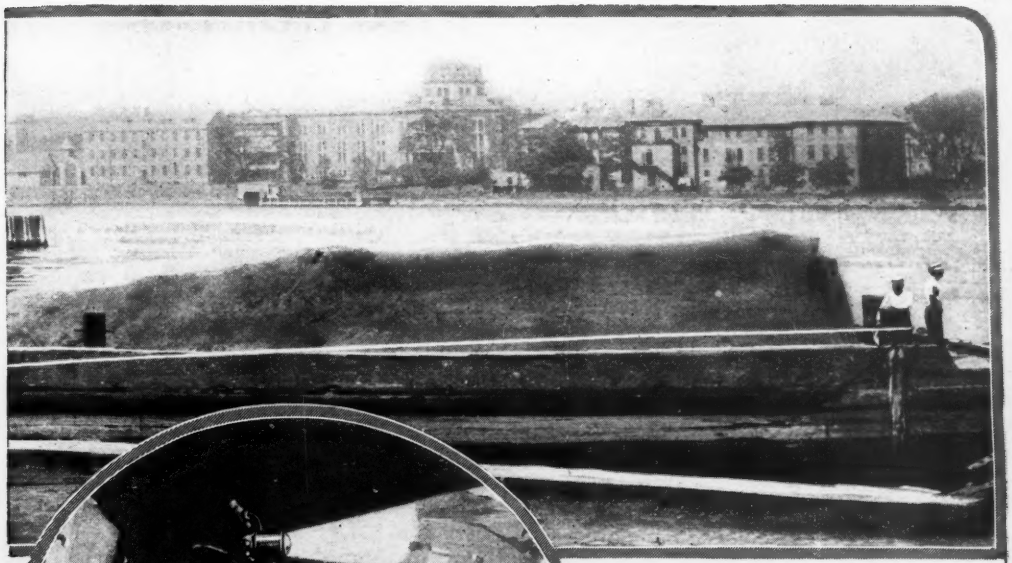
At left: A motorcycle clothes closet which delivers garments without creasing or wrapping them. A dozen hangers hold the clothes high enough so that bundles can be placed under them

Below: The "health wagon" of the Wisconsin Anti-Tuberculosis Association. It carries its own motion-picture show and professional "barker"

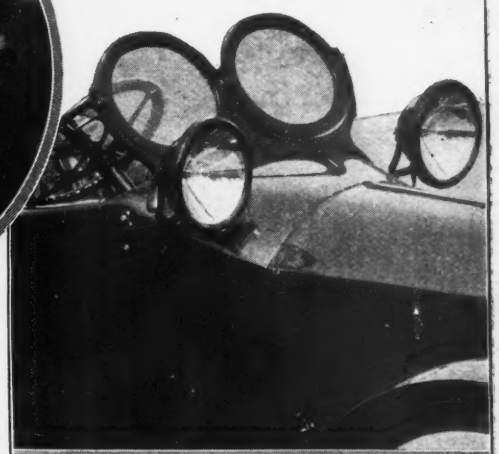
Below: Illuminated fenders instead of headlights. The light is thrown forward and downward, so that it shows up the condition of the roadway immediately in front of the automobile



Save Time, Health, Labor or Money



Above: A finger signal light which secures its current from the main headlights. The driver uses it to signal to following vehicles when he wants to stop or turn



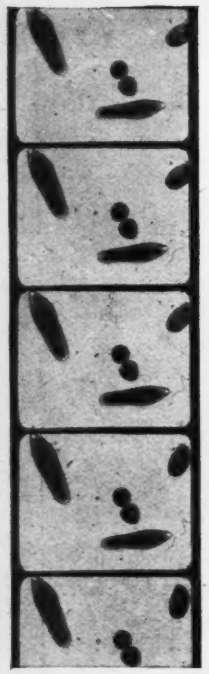
At right: An eyeglass wind shield which may be adjusted to any angle desired. It is as strong as a liner's porthole, which it resembles somewhat

At left: A vibration-proof clock encased in hard rubber. It is attached to the dashboard. A recent invention consists of a clock in a rubber case attached to the steering wheel

At right: The easiest riding seat a baby ever had. The basket is suspended by a strap and springs attached to the rear cover rib of the car

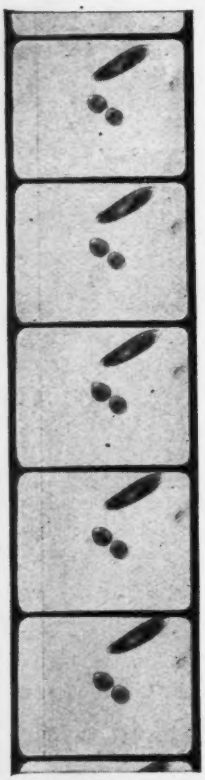
How Life Begins

A wonderful motion-picture which shows how microscopic cells multiply and how butterflies and higher animals grow



A protozoan, the simplest living animal organism

To photograph butterflies in the act of laying their eggs and to explain the development of the life that eventually emerges from the eggs, Mr. Stone invented the special camera and glass here shown

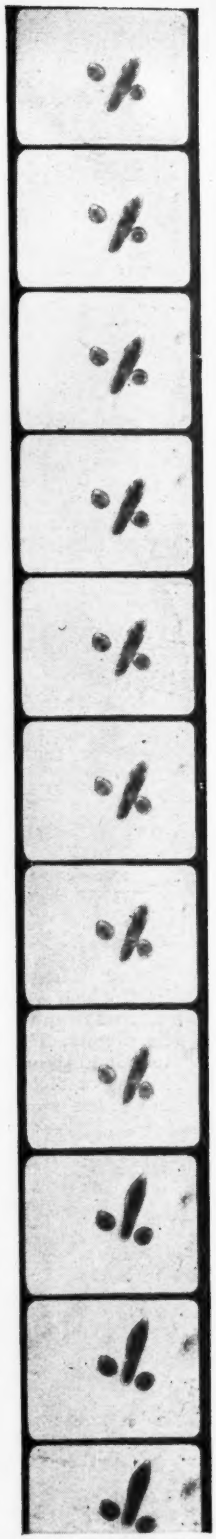


The protozoan divided. Each one becomes two

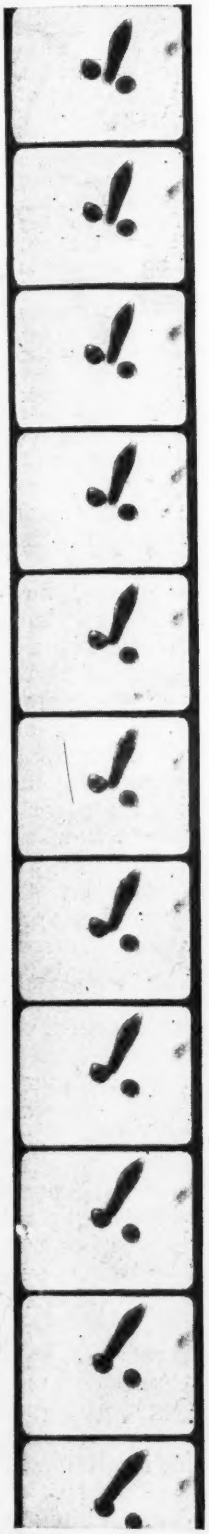
OF course you have seen on the screen those wonderful pictures in which a budding rose unfolds itself petal by petal, swells into full bloom and then shrivels and dies—all in five minutes. How is it thus possible photographically, to compress spring, summer and autumn into a few hundred feet of film? The pictures are obviously real—and yet how dramatically unreal is the ephemeral life that flourishes and dies before your eyes!

A motion-picture camera makes sixteen exposures per second. The resultant pictures are thrown upon the screen at the same rate. Instead of taking sixteen pictures per second, suppose that one were taken every hour and suppose further that the sixteen positives, ultimately obtained, are run through the projecting machine in a single second. Obviously, a process which was photographed in sixteen hours would be revealed on the screen in one second.

Here we have the secret of the rapidly unfolding and withering rose. An automatic camera took a photograph of the flower two or three times a day, but the final film obtained was projected on the screen in a few minutes. The effect is as if a miracle were being performed before our eyes.



Portion of the film showing divided protozoan's career



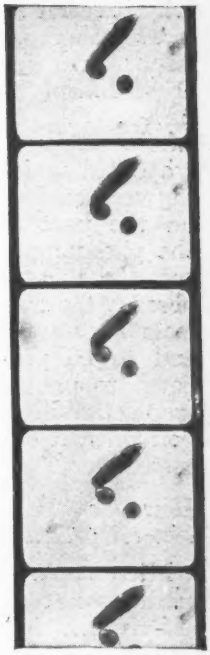
Different stages in the division of the protozoan

Mr. George E. Stone, of Berkeley, California, has hit upon the idea of applying this principle to make clear the complex subject of life and the methods by which plants and animals are born, live and die. With the assistance of Dr. J. A. Long, Professor of Embryology in the University of California, a film has been prepared which not only surpasses anything that has hitherto been attempted in showing the blossoming of flowers, but which is of immense scientific importance as well. No doubt other scientific men have had the same idea. But for lack of a suitable apparatus they were unable to photograph the minute life which is seen only through the microscope. This, Mr. Stone has invented. Some of the remarkable films which he has obtained are reproduced in connection with this article.

Simple Cells Merely Split in Two

The simplest plant or animal is that which consists of but one cell. Hence his film starts its photographic lesson in "How Life Begins" by showing a swarming mass of protozoans—simplest of all animals, because their bodies consist of but a single cell each. A protozoan reproduces its own kind by the simple process of splitting itself up into two parts. That fact the film drives home very clearly. A protozoan, highly magnified, is observed to constrict and divide in the middle. Each of the halves thus formed at once becomes a new one-cell creature. And each of these new creatures, in turn, splits up into new cells, until they become so numerous that at last one realizes

In making motion-pictures of microscopic life, Mr. Stone used the electric arc. The camera was driven by an electric motor controlled by the foot

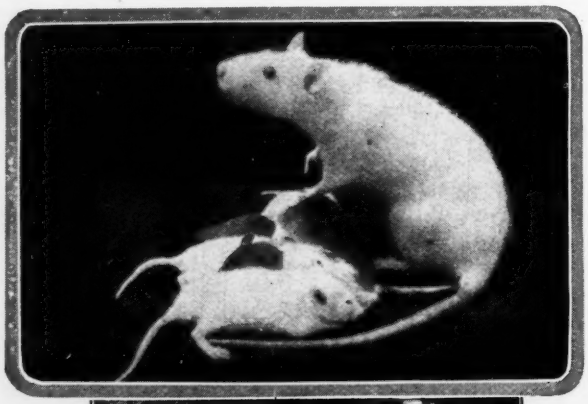


It was a three weeks' task to take this strip of film

New protozoans resulting from a division of an original protozoan

why it seems necessary for animals to die.

This short scene (it lasts only fifty-five seconds) was most difficult to take. Three whole weeks of watchful waiting were required on the part of the photographer. He had to observe the animals constantly and to be prepared to photograph the division when it occurred.

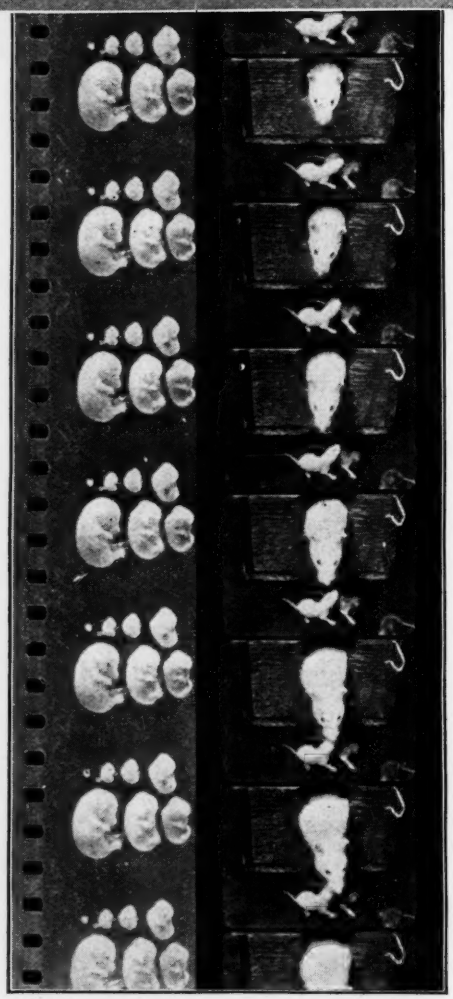


To the left is an enlargement of one of the hundreds of pictures made to show the development of the rat from the embryo to the living litter. Since the rat is a higher animal and the processes of life are explained from the crudest to the most complex forms, this portion of the film is near the end

How the Yeast Cell Reproduces

Microscopic life reproduces not only by self-division but also by budding. To bring out that fact, the common yeast plant, used in bread-making, was chosen by Mr. Stone as a motion-picture subject. The yeast is a one-celled plant. It reproduces by a process of budding which closely resembles the division which takes place in the protozoan. The yeast cells bud slowly. In order to secure a record of their growth, the photographs were made at intervals of four and one-half minutes over a period of twelve hours. Since they are viewed at the rate of sixteen per second, the growth is witnessed in the short space of ten seconds.

The film next exhibits to us the reproductive processes of higher and more familiar plants. It shows that they reproduce their own kind either from cuttings or from seeds. A slip of geranium was planted. One photograph was made every six hours. On the screen a growth is shown in one second which took place in four days.

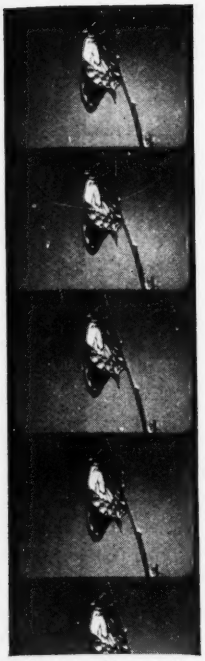


Section of the film showing the development of a rat's embryo. All life develops from cells, in the same way

The mother rat coming out of her box and picking up her progeny one by one in her mouth, dropping them into the nest

Most plants, however, develop from seeds, and the seeds, in turn, originate in the flowers of the parent plant. To bring out that fact, photographs and diagrams of the sweet-pea are presented to show how the pollen grains from the anthers fall on the stigma and there proceed to grow and send out tubes. The tubes work their way down through the coarse tissues of the style until they reach an ovule. Then the whole process of fertilization is revealed—how the fertilized egg cells become peas while the pistil of the flower becomes the pod which surrounds and shelters them.

Much more difficult was the problem presented by the higher animals. With them life begins in a fertilized egg cell. The first animal shown is the sea urchin, close relative of the starfish. On the



The swallow-tail butterfly laying her creamy-white eggs on the anise

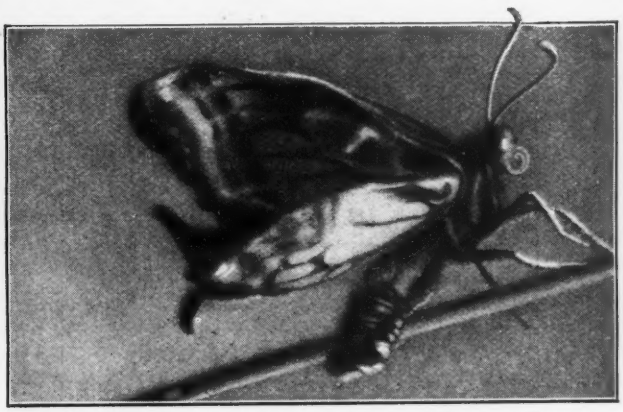
The beautiful eggs of the swallow-tail butterfly as revealed by the film

screen, two eggs are shown, bombarded by millions of spermatozoa. The fact that the fertilization of an animal egg is fundamentally the same process as that previously witnessed in the plant, drives home the essential similarity of the reproductive processes in the animal and vegetable kingdom. In every case fertilization consists in the fusion of two specially organized cells. After fertilization, the cell resulting from the union proceeds to divide into many cells, which finally colonize into what is then an embryo.

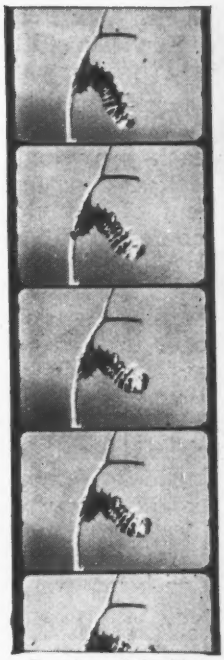
From Egg to Golden-Winged Butterfly

Full of dramatic interest is that section of the film which depicts the life history of a butterfly—one of the "swallow-tail" variety famous for the yellow and black of its body and its "eye spots" of red and blue. A mother swallow-tail is shown on the screen laying her beautiful creamy-white eggs on the sweet anise. Four days later—on the screen only a minute later—a small black caterpillar emerges from one of the eggs. It feeds. In order to grow, it sheds its skin and emerges with a new and more beautiful one. Another period of feeding intervenes. Now it is revealed spinning a silken loop and attaching itself to a firm support. Then the marvelous process of skin-shedding is unfolded. A chrysalis has been formed. For many months this hangs motionless. Then, as the film unreels, it suddenly shows signs of life. At the end of two days—a few seconds on the screen—it bursts open and releases a limp, curious insect with crumpled wings. This is the new butterfly.

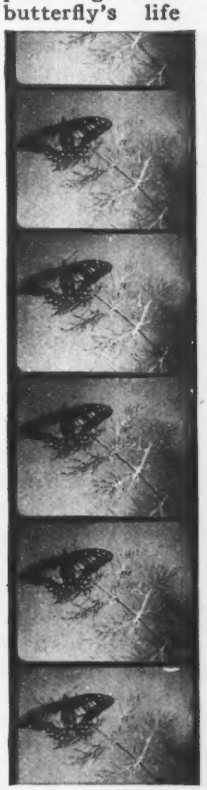
So, other life processes are explained—those of the frog, the chicken, the rat. When the last foot of film has flickered past, you come away with the feeling that man himself is mysteriously linked with that simple protozoan which you saw in the beginning, and that the process of growth and development is the same in all the living universe.



A dramatic moment as the film unreels is that when the butterfly struggles out of the chrysalis. It has passed through many stages since the egg was laid, but now its limp wings expand and it soars away



Portion of the film showing the caterpillar stage of the butterfly's life



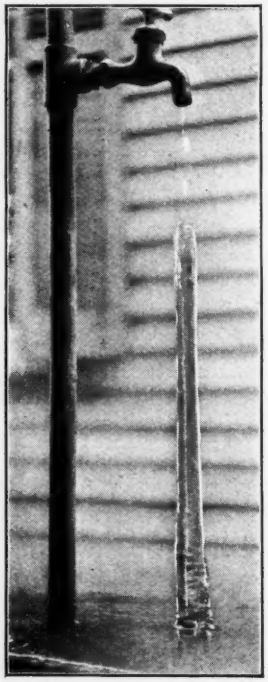
The butterfly flits joyously away after having emerged from the chrysalis

What Jack Frost Did with a Fountain of Running Water

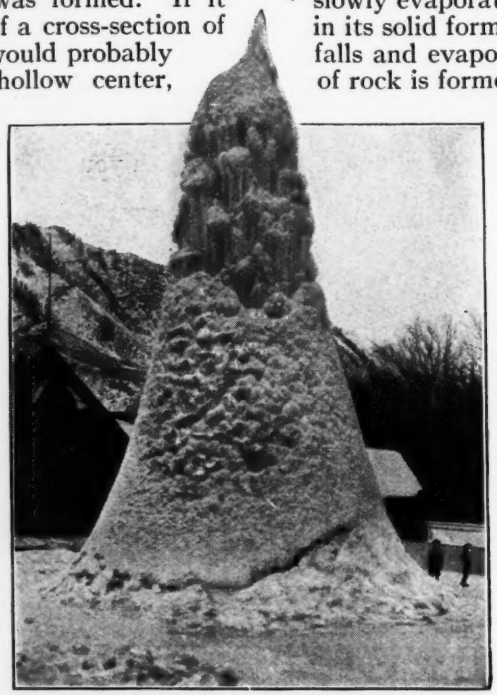
JACK FROST is our deftest and daintiest architect. He builds millions of structures each year and draws other billions of patterns. The problem of being original never bothers him. Each snowflake is an artistic triumph; each frosted window-pane is different in its every detail from the countless billions which have appeared since the beginning of time. No, Jack Frost doesn't bother about patent and copyright laws. If he were so inclined he could secure a patent on every snowflake that falls.

The accompanying illustration below shows what he has done in the way of an ice cone. Next winter he will make one in the same place—and make it so it won't infringe on the rights of this one. The material he worked with here was a spring which gushed up into a fountain.

As the ice formed, the water was raised higher and higher from pressure underneath until the cone was formed. If it could be examined or if a cross-section of it could be obtained it would probably be found to have a hollow center, growing gradually smaller and smaller in diameter. The fact that the running water had considerable pressure from a high fountain head and that water will find its level made it possible for Jack Frost to fashion the cone. However, the fountain isn't so important after all. He could do equally well with a stream of water from a garden hose, if it were made to spout upward in the same manner and left long enough in that position in weather of the proper temperature.



This great stalagmite of ice was formed drip by drip



The cone was formed gradually from circumference to center until the highest peak was reached

An Icicle Which "Sprouted" Over Night

WHO ever heard of an icicle growing upside down? There was one particular icicle which was not contented with the usual order of things and accordingly decided to grow from the bottom up. The water as it fell drop by drop from a faucet one very cold night in Beaufort, North Carolina, froze before it could travel very far on its journey. Slowly, as the water froze, the icicle grew, and when morning came the "sprout" had reached a height of twenty inches.

It is interesting to note that the huge "icicles" of rock which are often found in caves of the mountainous districts of the United States are formed in a way that is very much similar to the way this icicle was formed. Underground streams of water, which carry various kinds of rock in solution with them, frequently empty into a cave at its top. The water dropping gradually from the roof of the cave, slowly evaporates and leaves the rock in its solid form. As drop after drop falls and evaporates, a giant "icicle" of rock is formed which is often made up of many attractive colors, though yellow, mellowing into brown is the most common. Some stalagmites, as they are called, when the base rests upon the ground, or bottom, of the cave, take hundreds of years to form. Often they meet stalactites (similar formations with the base attached to the ceiling or high projection in a cave) and thus form a continuous column. The Mammoth Cave in Kentucky contains many specimens both of stalactites and stalagmites.

A Winter Experiment with Bulbs

Growing two decidedly different hyacinths on one stem

The bulbs are cut in half, only the half containing the central shoot being required

The resultant cluster will have all the characteristics of the two different bulbs including colors and single or double flowers

The two halves of the bulbs used must be fitted accurately together and tied securely

The cut edges should be separated by moss, as shown at the left. The soil should be kept moist but not too damp

TO raise two hyacinth bulbs together so that they appear to be one plant, well developed bulbs should be selected, and, in a general sense, the more distinctive these are the better. The colors of the blossoms should be as widely different as possible. It is well to make sure that the bulbs will bloom at about the same time. The best results are secured when the bulbs are started during the month of January.

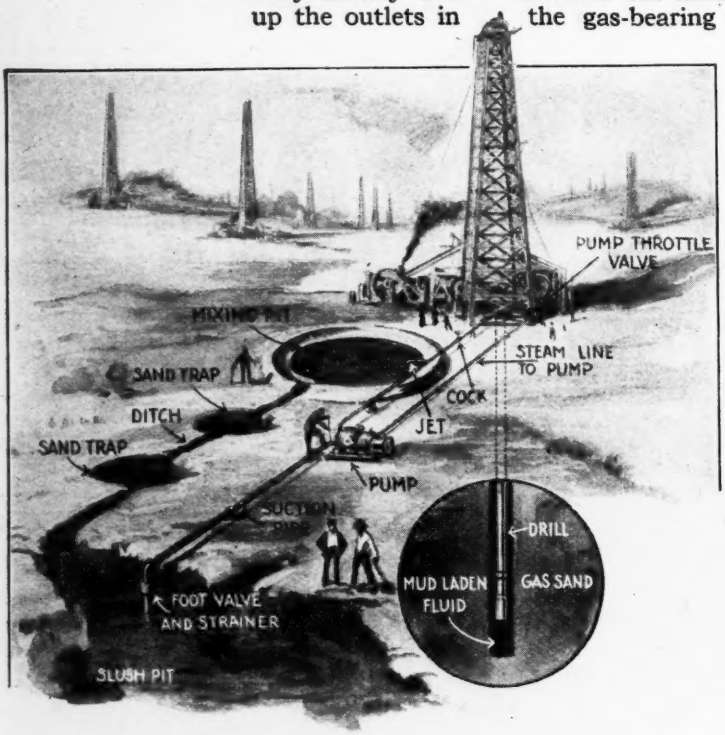
Cut each with a sharp knife, right down from the crown to the base, so that the side of the central shoot containing the leaves is exposed. Great care must be exercised in order that no injury be done to the shoot. The smaller halves of the bulbs are useless and may be thrown away. Put the two larger portions together so that the open ends fit easily face to face.

With some twine or raffia tie the portions firmly to each other so that a single big bulb is formed. Put a little moss in between the cut edges in the manner shown.

The made-up bulb may be potted, care being taken to ram the soil around it more tightly than usual. Moreover, a good third of the bulb should be allowed to stand up above the surface of the mold.

Saving Natural Gas with Muddy Water

Why muddy water? Because the mud clogs up the outlets in the gas-bearing sands



The clay and water are mixed in outside pits and then pumped into the wells. The mud effectually plugs up the gas-bearing sand without interfering with the drilling

IN boring for oil, work is frequently hindered by unexpected gas-bearing sands. Huge quantities of valuable gas are thus allowed to escape, because it is oil, not gas, which the workmen are after.

The Government Bureau of Mines, noticing this waste, has recently evolved a method of reducing and practically preventing it, without in any way hindering the work of boring for oil. Thus the gas is conserved for later consumption. Besides, it is made far less dangerous for the workmen to operate the drilling machinery.

The method makes use of so simple a remedy as muddy water—a material sometimes dignified by the technical name of "mud-laden fluid." It is based on the principle that a drill-bit on the end of a long cable can go up and down in fairly fluid water almost as readily as it can in a dry hole and hit the bottom of the hole just as hard. The muddy water in the well opposes the outflow of gas. Why muddy water? Because water has a tendency to become muddy by loosening material from the sides of the hole, causing caving and unending difficulties. If the water is already muddy, the solid material carried in suspension soaks into the gas-bearing sands as they are encountered, effectually plugging them up, at the same time permitting the drill to work on the bottom of the hole. It is little hindered by the presence of the water. If the gas pressure is great, the well can be nearly filled with the muddy water, the weight of the resultant liquid column being sufficient in most cases to stop any outflow of gas bubbles, thus reinforcing the efforts of the mud which has soaked into the gaseous sands.

The mud-laden fluid is usually made up of about twenty per cent clay and the rest water. Sticky clays, such as gumbo, are most effective. The clay and the water are mixed in outside pits and then pumped into the well. The precise methods by which the pumping is done depend upon various factors, such as whether the well is already blowing gas or not, whether the well is deep enough so that a water column is sufficient to hold back the gas pressure without external aid, and similar considerations. In each case simple expedients are used, the desired end being to get the muddy water into the hole with as little danger of asphyxiating the workmen as possible and with as little loss of the gas as may be. A well once sealed up with muddy water in this fashion may be opened at any later time simply by pumping out the water. The gas pressure will at once overcome any opposition of the mud soaked into the sands.

Thus the owner of the well may keep the gas bottled up in its natural reservoir until such time as he may find use for it.

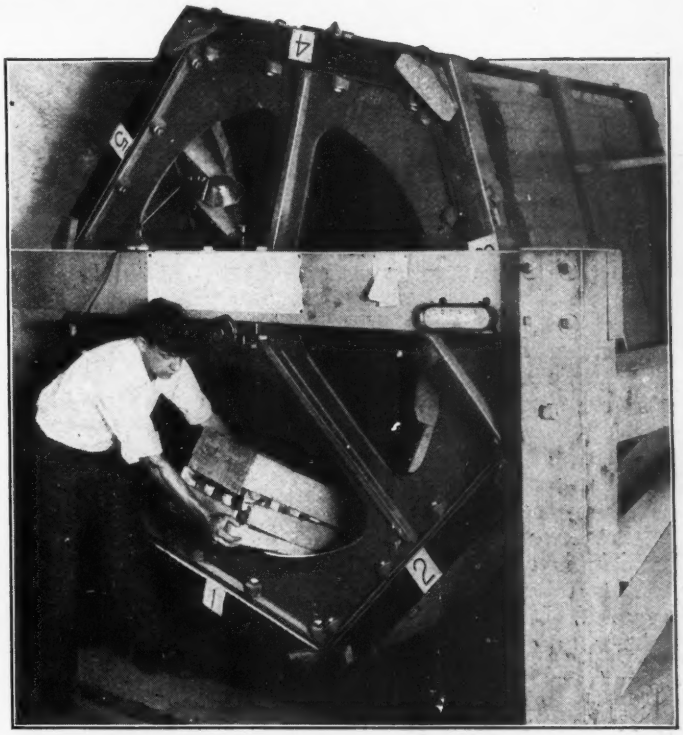
A Machine Which Abuses Boxes to Find Out How Strong They Are

TO determine the best kind of box construction for a given purpose, a machine for testing boxes is now in operation at the Forest Products Laboratory, at Madison, Wisconsin. This machine was devised by the engineers of the United States Forest Service after consulting the American Society for Testing Materials and the National Association of Box Manufacturers.

As more than four and a half billion feet of lumber are used in making boxes every year and as many boxes are broken in transit, with injury to their contents, it is hoped to effect a big economic saving by finding out through this machine just what are the best methods of box construction.

The machine has an hexagonal drum, the sides of which measure three and a half feet. The drum is lined with sheet steel. Pieces of scantling bolted to the bottom form the "hazards." Boxes filled with cans of water are placed in the drum. It is then rotated. The hazards carry the boxes part way up and then they fall back into the lower part of the drum. The boxes are watched carefully, and the number of falls they withstand and the manner in which they break are carefully registered.

As a result of these tests the way in which the boxes are nailed has been found to be very important. One more nail to each side of a box gives it much greater strength. Proper nailing will allow a reduction in the amount of lumber used, without decreasing the strength of the box. Boxes with cleated ends are found to be very strong. The quality of the lumber is found to be less important than the manner of construction.

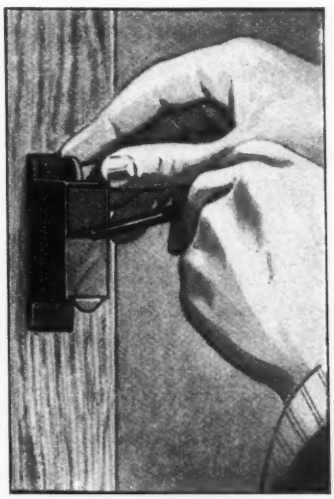


Boxes filled with cans of water are placed in the hexagonal drum which is then rotated. The results of falls are noted

At Last! A Device for Extracting Rusty Pen-Points

THE usual method of extracting rusted pen-points from their staffs, is to pull them out with the fingers, if it can possibly be done. Inky fingers are the least of several evils resulting from this method of procedure. Among others is the chance of cutting the flesh and adding a ruby color to the ink-marks made by the besmeared fingers.

A pen-extractor screwed to the wall or desk will serve the entire office or classroom, where such pens are used, and will do its bit toward effecting the smooth and rapid carrying out of the daily routine. The pen-point is shoved as far as possible through the door or shutter of the device, which grips it automatically. With a pull on the staff the point is extracted. A receptacle is provided into which the discarded point falls.



The point is shoved into the device which grips it so that it is extracted with a pull

Filling in Trenches by Machinery

One man can back-fill the largest trench in the shortest possible time

THE two new vehicles shown in the illustrations below are designed to reduce the cost of back-filling trenches by eliminating shovelers, horse-drawn wagons or costly overhead cableways. The smaller of the two machines is intended for working on small trenches where the material to be back-filled is near the trench. The larger apparatus is equipped with a boom and an automatic scraper on the boom cable, so that one man operating the machine is sufficient to back-fill even the very largest trenches.

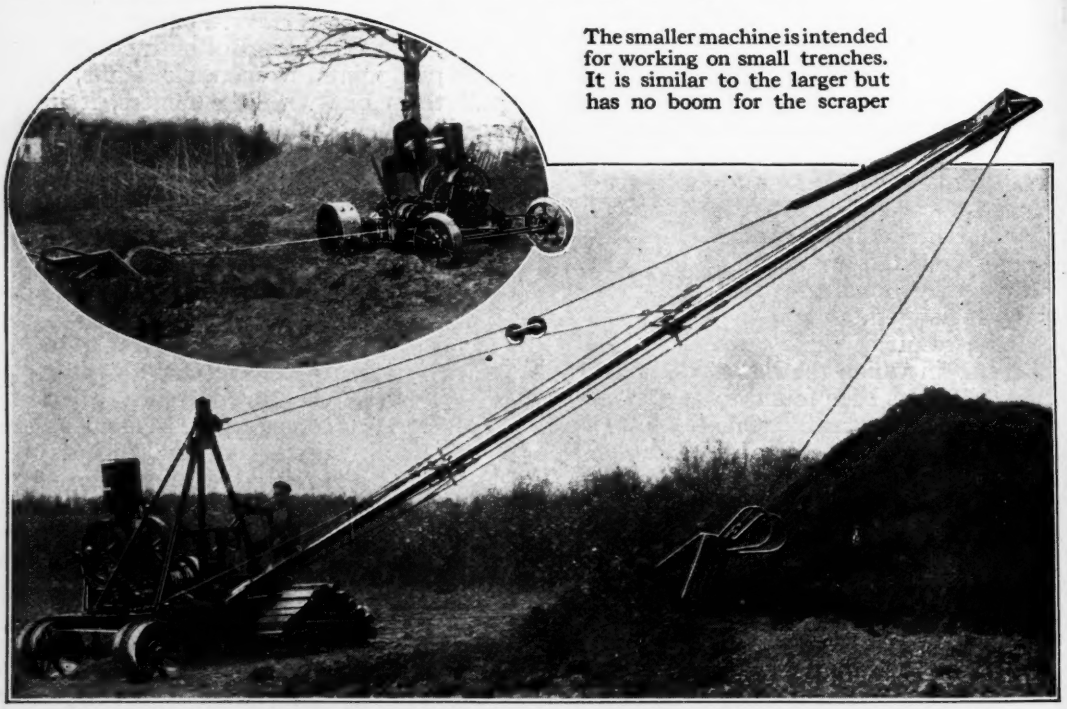
The special feature of the machines is that they are self-propelling and move along with the work as it progresses. The larger vehicle is equipped with caterpillar rear wheels to enable it to negotiate uneven ground. It has a low frame, with small wheels, and a low center of gravity to prevent it from tipping over when the boom is in use.

The boom telescopes, so that it can be adjusted in length to suit the work, and is fitted to swing around to the side of the machine while still attached. Hence the vehicle can travel along streets or roads without the delay that would invariably be caused were it necessary to dismantle the boom each time the location of the work is changed.

A one-cylinder gasoline engine is used to propel the apparatus and to operate the boom cable. One man is sufficient to run both the machine and the scraper. The scraper is pulled from the dirt-pile to the trench by means of a rope over the boom; it is brought back to position for the next load by a second cable on the back of the scraper.

The smaller machine is similar to the larger, except that it has no boom and requires the services of a second man to pull the empty scraper back into position for loading.

Equipped with the caterpillar-tread the machine can approach the very edge of a trench without causing a cave-in, or it can work in soft ground or in a plowed field with comparative ease. It is preferred to the larger machine for small jobs and is, of course, less expensive.

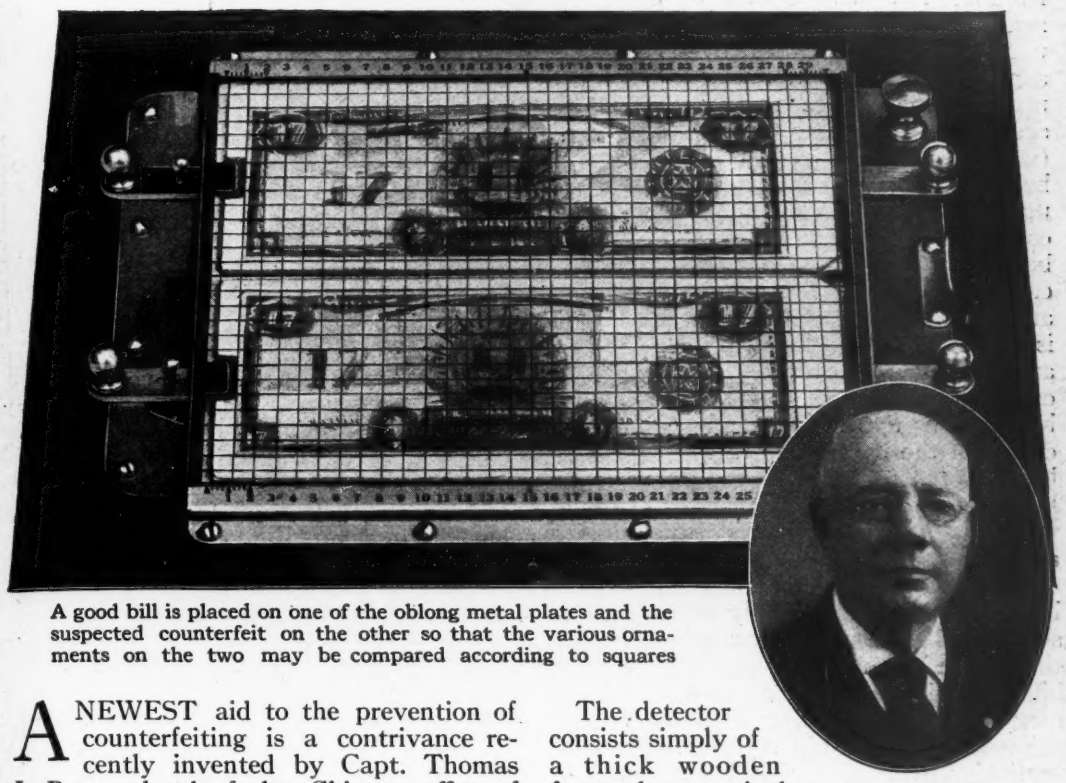


The smaller machine is intended for working on small trenches. It is similar to the larger but has no boom for the scraper

A one-cylinder gasoline engine is used to propel the apparatus and to operate the boom cable which pulls the scraper to and from the trench. One man can run both machine and scraper

Is that Ten-Dollar Bill Good or Bad?

Captain Porter of the United States Secret Service invents a machine which detects counterfeit money



A good bill is placed on one of the oblong metal plates and the suspected counterfeit on the other so that the various ornaments on the two may be compared according to squares

A NEWEST aid to the prevention of counterfeiting is a contrivance recently invented by Capt. Thomas I. Porter, head of the Chicago office of the United States Secret Service. His machine is especially intended to detect counterfeit bills or coins at the moment the possessor attempts to pass them at a bank. Through the aid of modern processes of printing and engraving counterfeits can be made so much like originals that they defy ordinary inspection. A special machine is necessary.

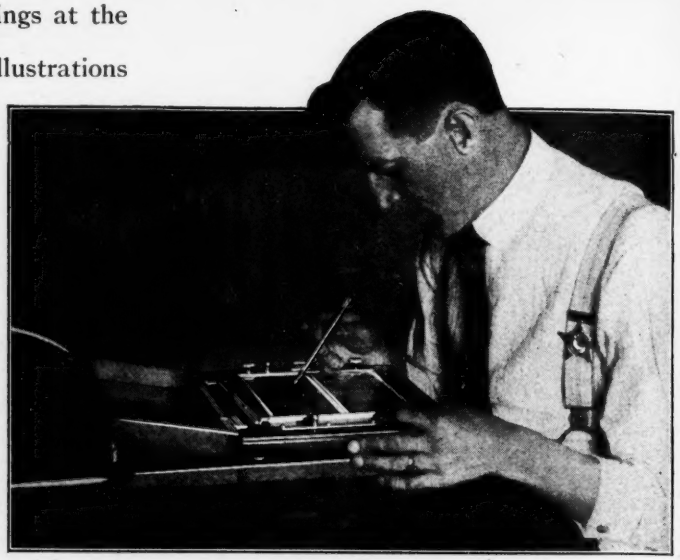
Captain Porter's contrivance depends on the principle that a counterfeiter rarely succeeds in making perfect original plates for his bills. Somehow or other there is always a slight distortion in some part. To the casual eye the products of the counterfeiter look exactly like those of Uncle Sam. But most plate-engraving processes make use of photography at one stage or another. The images of the bills must pass through a lens, which passage is sure to distort them. Though the distortion is slight, minute comparison with a good bill reveals the defects. The new machine is designed to make the work of comparison easy.

The detector consists simply of a thick wooden frame about ten inches or a foot square. On the top surface, brass edgings are provided which hold in place a large plate of glass—this being divided into squares about one-fourth of an inch apart. Several glass plates are provided, each with a different set of rulings suited to the fineness of the bill undergoing test. Beneath the glass plate are two thin oblong metal plates faced on their upper surfaces with blotting paper or other material having a rough surface to which a bill will readily adhere. These metal plates rest side by side beneath the glass and are provided with handles at each end extending beyond the glass. By means of the handles the bills may be shifted around under the glass at will.

In using the machine, a good bill is placed on one of the oblong metal plates, and the supposed counterfeit on the other—each adhering to the blotting-paper upper surface of its respective plate. The ruled glass is then placed down over the metal plates and their accompanying bills, and

held in place by the brass edgings at the side of the contrivance.

It will be noted from the illustrations that the vertical lines on the glass are numbered serially from left to right. The horizontal ones are divided into two sets, each designated by similar groups of letters. The user of the device merely slides the metal plates around (using the handles projecting beyond the glass at each end) until, say, the upper left-hand corner of the good bill rests beneath the point A-1 of the cross-hatching on the glass, and the remainder of the bill is correspondingly lined up and square with the rest of the cross-hatching. Similarly he brings the upper left-hand corner of the bad bill to rest beneath the point *A* of the lower section of the ruling—afterward likewise bringing the other parts of the bill into agreement with the rest of the squares.



The various ornaments on the bills are compared for accuracy of size and shape. The plates are moved around by means of the handles at the sides to facilitate the comparisons

All of this has the effect of placing a good bill and a bad bill squarely before an observer, and because of the cross-hatching on the glass, of dividing up the surface of each bill into similar squares, each of which may be compared in detail. As is readily evident, if the bad bill is distorted in any particular, the defect will immediately become apparent under such close scrutiny as this sectionalizing into small squares makes possible.

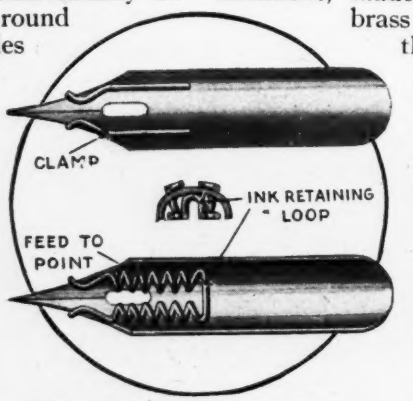
The most valuable feature about the device is the fact that the two oblong blotter-faced metal plates and their accompanying good and bad bills, may individually be moved up and down and round about by means of the handles at each side and a variety of comparisons made, all without disturbing the glass itself in any way.

The tests performed usually consist in comparing the various ornaments on a bill for accuracy of size and shape—the moving around being a valuable feature, since the ornaments do not always happen to fall completely within a set of squares.

Counterfeit coins are compared in the same way as bills, only a finer screen is necessary. Counterfeit money has to be good indeed to pass the kind of a test this machine can give it.

Providing Your Pen with an Automatic Fountain

OF course every boy wants a fountain pen. He will buy one the very first chance he gets; but good fountain pens are rather expensive for the purse that goes with "knickers," and an unreliable one is likely to prove such a disappointment that it is worse than none at all. However, you can add the advantages of a fountain-pen to any ordinary pen-point by a new attachment, made very simply of spring-brass wire. The main part of the attachment lies in two small coils which are fixed under the point of the pen to hold the surplus ink. These coil ends join at the rear, while those near the front of the pen are turned up and back to fit tightly against the top of the pen. The jaws so formed serve the purpose of clasping the attachment to the pen-point and of uniformly feeding the ink to the point as it is needed.



Spring-brass wire, bent as here shown, will convert any nib into an automatic fountain pen

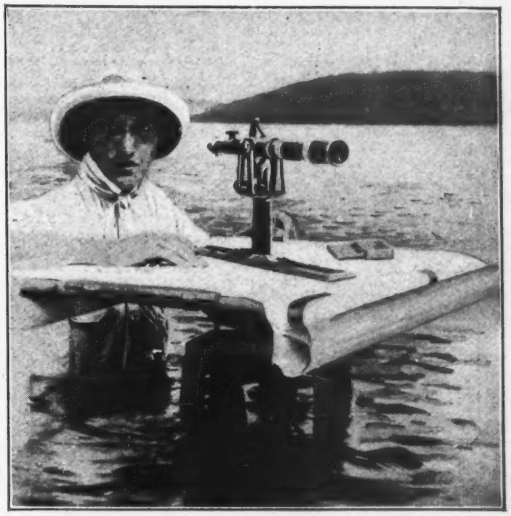
Salmon Fishing at the Mouth of the Columbia River

IF a fisherman has luck when seining for salmon, he generally gets a haul weighing many tons. It is perhaps for this reason more than for any other that so many launches and seining-skiffs may be seen with their nets just inside the great promontory near the mouth of the Columbia River. For net-fishing for salmon—seining, as it is called—at this fruitful spot is nearly always very dangerous. Nevertheless, in some seasons nearly five hundred tons of Chinook salmon—the most valuable and most prized fish of the species—are taken by a single crew. Individual hauls sometimes reach eighteen tons, and the record catch for one day has reached as high as fifty-two tons.

Because of the promontory on one side of the fishing-grounds and Sand Island lying directly opposite the river's mouth, the breakers constantly ride high. When the steamers of the Great Northern Pacific ply through the narrow grounds at a speed of twenty-three miles an hour, the breakers pushed out from their side pile so high that fishing is utterly impossible. If the launches and skiffs are caught too close inshore to weather the breakers, there will be little chance for them to get to safety.

Certain conditions seem to be most favorable to the formation of high waves by the steamers. During an ebb tide and an off-shore wind, the water is piled into solid waves often six and eight feet high. The suction produced at the sides of the steamers is very great, and heavy nets are known to have been drawn in from a distance of two hundred feet and finally destroyed by the rapidly revolving propellers of the ship.

Salmon fishing at the mouth of the Columbia River is dangerous. Small skiffs and launches are often capsized and thrown high and dry on the beach if not dashed to pieces



The instrument used in making the coast surveys is a telescope mounted on a portable tripod and having a delicate spirit level

Endangering Your Life for an Imaginary Line

FROM the mosquito-infested swamps of our lowlands to the highest peaks of our mountains and from the ice-locked northland of Alaska to the blistering sands of the tropics, the engineer in the service of the United States Coast and Geodetic Survey is facing privation and hardship for the sake of precision. He is laying a network of imaginary lines upon the maps of the States that we may know just how high a given place within the national boundaries is and in just what latitude and longitude it lies.

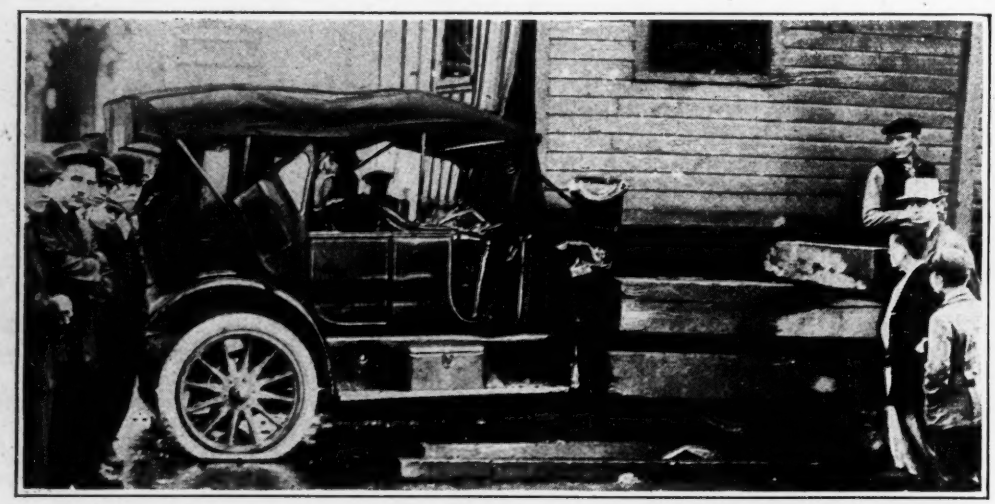
Thus, the surveyor in the accompanying photograph is establishing a line along a coast where it is necessary for him to stand in water up to his waist. He is obliged to work from this particular spot because it enables him to see his observation point far away on the horizon. Otherwise he could not make his measurements and establish his line.

However, he is taking fewer chances while he is working in the water than when he is establishing a line in a heavily wooded country. Where the land is flat and the trees of excessive height he sometimes has to work on giddy platforms more than a hundred feet above the ground.

Freakish Accidents

Your home—the most dangerous place in the world

CAREFULLY compiled statistics show that at present the number of accidental deaths occurring annually in this country amount to about seventy-eight thousand, and more than eleven million injuries result from accidents yearly.

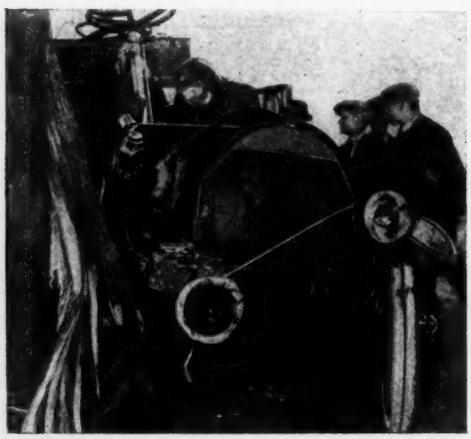


An automobile attempted to crawl under a house which it found unexpectedly in the roadway. Two men were pinned under the front seat and the fire department had to be called upon to jack up the house in order to release them. They were not seriously hurt

Industrial accidents have a place of their own. Large as their number is, and their increase up to a few years ago was constant, yet the problem of industrial accidents is under process of control. But in relation to the unavoidable accidents to which all men are liable no such means of prevention are applicable.

Our streets are daily becoming more and more congested. Our activities seem constantly to increase. Men rush to save a minute of time with nothing to do with it when it is gained.

One of the most interesting facts is the mitigation of old and the rise of new hazards. This process is going on to a greater or less extent in every direction. For instance, fifteen years ago bicycles were a considerable cause of accident. The automobile was unknown. To-day the bicycle has practically disappeared as a cause while the automobile has rushed from obscurity to the third place in importance, contributing in 1915 nearly twenty per cent of the total number of accidents.



This fire truck, traveling at full speed, ran into a tree. The truck was wrecked and two firemen were seriously injured

Contrary to belief, street accidents occur oftener in the least congested areas, rather than in places where traffic and people are most congested and the danger more apparent.

The percentage

of accidents is greater in the city than in the country, and the months of June, July, August, September and March in their respective order, furnish the greatest number.

Examine the claims paid by the insurance companies and you get some idea of the limitless diversity of accidents, of serious results from trivial causes, of miraculous escape with slight injuries, of the tragic and humorous causes that would fill five hundred pages without a repetition.

"I was asleep," said one claimant, "and dreamed that a wild bull was rushing after me, when I kicked at the imaginary animal, striking the wall violently and breaking my foot."

"While assisting a lady to board a train, the point of the umbrella which she carried under her arm, was accidentally thrust into my left eye, destroying the sight," complains another.

© Int. Film Serv.

Photograph taken during the Astor Cup Race, at Sheepshead Bay, New York, recently. Ruckstall, one of the contestants, is shown crawling out from under his car, which turned turtle while rounding a curve at terrific speed. He was slightly injured but his mechanician and the car were unscathed

A third has been around the world three times and never been injured, but stepped in a bucket left on the cellar stairs and fell, breaking both his legs.

"Shoveling coal in a furnace when a shot cartridge which was in the coal exploded and the charge entered his right side," reports an accident company of one case.

"Was walking in front of his house when the wheel which had come off from an automobile and rolled a block, struck him, fracturing both bones of the right leg," reads another report.

"Stepped on the tail of a cow which arose and threw him on his head causing concussion of brain." It's true, too.

"Slipped in the bathtub and fell, rupturing the spleen." It happens more frequently than might be supposed.

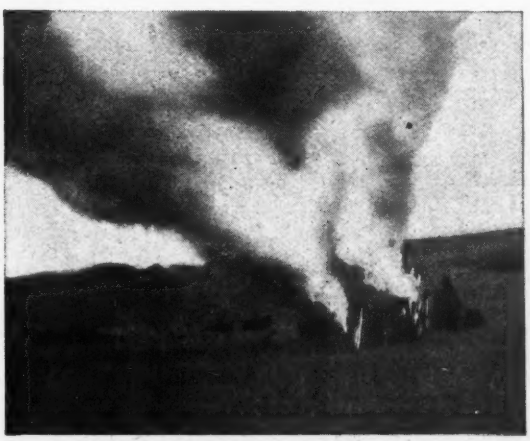
"While asleep in a hotel the building caught fire. In endeavoring to get out of bed, I was caught in the bedclothes and fell against a table, fracturing three ribs."

"I was chasing a rooster with some scissors to clip his wings, and fell, driving the scissors into my own body." It sounds absurd, but it happened.

A Port Jefferson man was electrocuted while taking a foot bath in a metallic tub. He had one foot in the tub half filled with water, when his head came in contact with an electric light fixture.

One company paid money (after investigation) to a man who "crawled under a bed for a stocking; a needle lying on the floor ran into his breast."

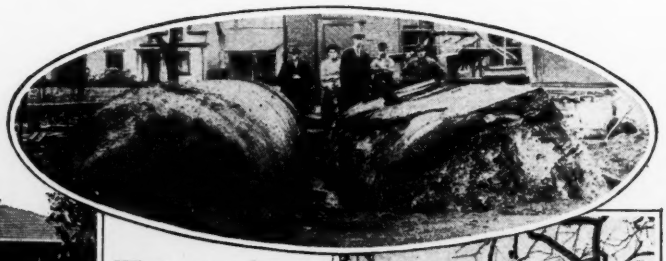
Accidents occurring at home contribute in normal years twenty-six per cent. of all accidents.



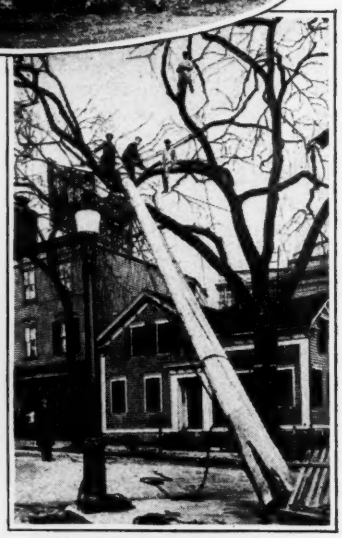
An instance of fires resulting from smut explosions in grain. Much valuable machinery is destroyed in this way during harvest time

Carelessness, Lightning and Floods

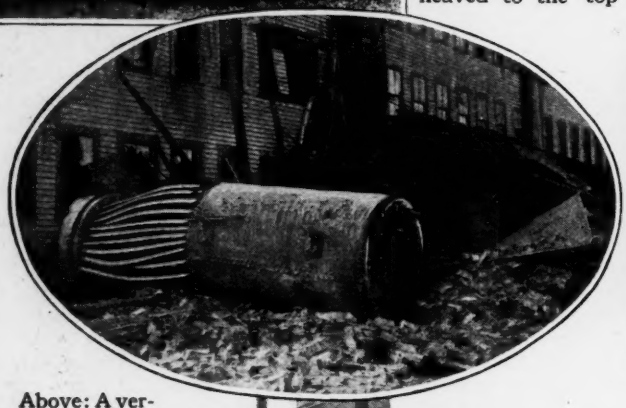
A smokestack which was twice struck by lightning. The second time about half a ton of loosened brick fell through the roof of the building



When waters from a flood sewer overran a gas plant these two buried tanks heaved to the top



This 150-foot flag-pole was blown over in a very high gale



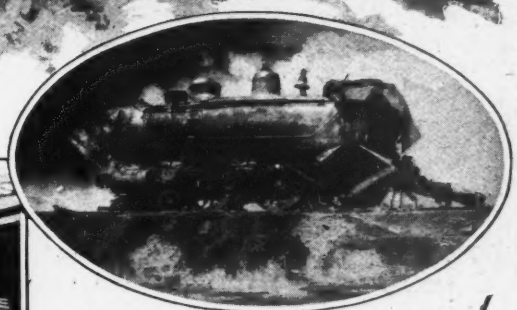
Above: A vertical tubular boiler used after being cracked and patched. Yes; it exploded

An accident caused by the treacherous character of the soil, which slid down and buried a locomotive and its track

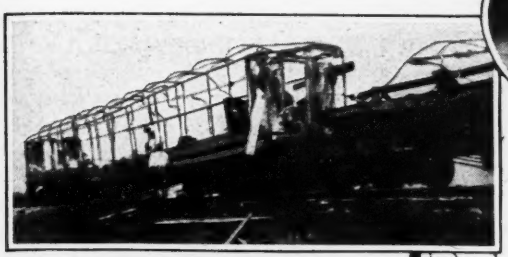
A locomotive speeding to make up lost time crashed through a mill near Titusville, Pa., completely wrecking the plant, its stock and machinery, but sustaining no injury to itself except broken windowpanes. No passengers were injured except from the shock of the impact, the steel coaches effectually safeguarding them

Write a Catalog of Catastrophes

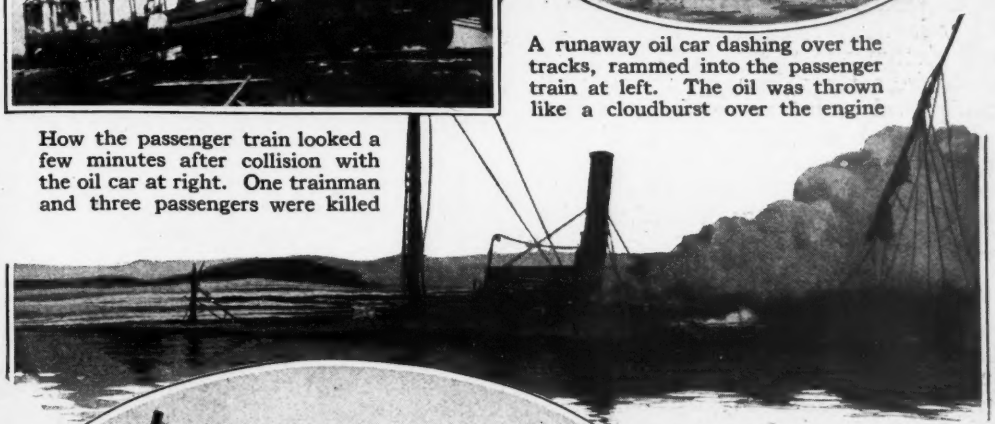
A submarine formerly used for scientific sight-seeing trips under sea. It was lost for years and finally found beached. Nothing was learned of the crew



A runaway oil car dashing over the tracks, rammed into the passenger train at left. The oil was thrown like a cloudburst over the engine

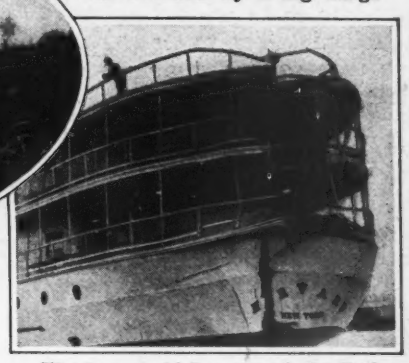


How the passenger train looked a few minutes after collision with the oil car at right. One trainman and three passengers were killed



A steam yacht lying at anchor was rammed by a big barge

This steamer carried a load of lumber and barrels of lime. Dampness penetrated the lime barrels, causing combustion and such intense heat that the cargo of lumber was affected and a spectacular fire resulted. Fortunately the steamer was not far from shore and all on board were saved



The barge which rammed the little steam yacht above. Engine telegraph signals were misinterpreted

The two photographs are pasted together in such a way that their edges register exactly with the curb lines

What Now? Has the Ocean Broken Loose and a Steamer Lost Its Way?

WE have read of the boat traffic on the streets of Venice, and have seen many interesting pictures, beautiful ladies and picturesque troubadours stepping directly from their doors into their waiting gondolas, but it remained for a Detroit photographer to give to the world a series of pictures of a steamer making its way through the street of a great city and of the ocean lapping the curb of a New York city street.

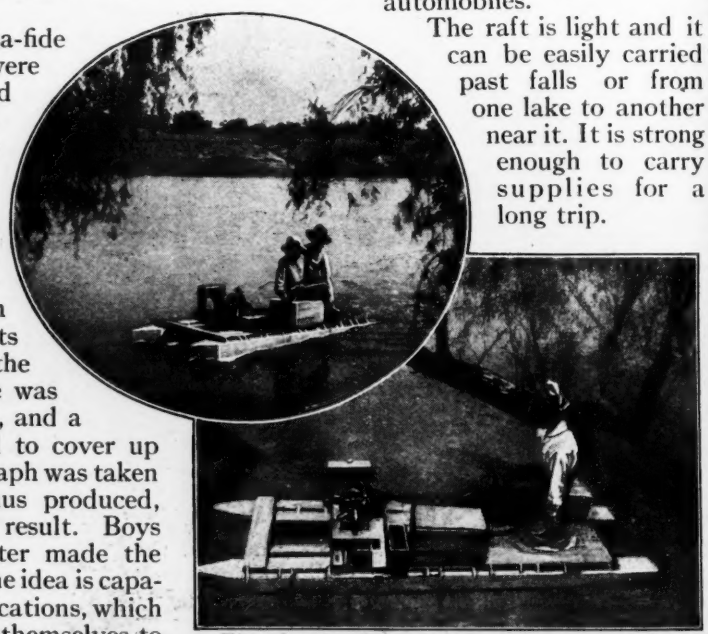
The pictures were not bona-fide photographs, however, but were the result of a very clever and legitimate trickery, which is simplicity in itself. To secure such a result as the above, he took separate photographs of the street scene and water scene which he wished to be combined. The water scene was then so cut that when placed upon the street scene its edges registered exactly with the curb lines. The water scene was pasted upon the street scene, and a fine spotting-brush was used to cover up any defects. When a photograph was taken of the composite picture thus produced, the above effect was the result. Boys swimming about in the water made the scene still more puzzling. The idea is capable of a wide variety of applications, which will only too readily suggest themselves to the photographic trickster.

Change Your Motorcycle into a Motor-Raft

ANY amount of sport can be gotten from a motor-raft, and for those having a motorcycle, it is a simple matter to make the transformation. The engine of a motorcycle is particularly adapted for such work, although any similar engine can, of course, be used. The raft shown in the accompanying illustrations was made by J. Dutton, a British soldier, serving in the present campaign in Africa. Being of a mechanical turn of mind he made it during the hours when he was off duty. When his vacation came, he spent three weeks in exploring the tropical rivers.

He mounted the one-cylinder engine of his motorcycle near the front of two pontoons which he made by soldering together a number of tins in which gasoline was supplied. To two eight-foot lengths of these, he soldered a bow and a stern which he formed from other tins. The propeller-shaft is carried under the platform fastened between the tops of the pontoons, connection being made with the propeller through a universal-joint of the kind used on automobiles.

The raft is light and it can be easily carried past falls or from one lake to another near it. It is strong enough to carry supplies for a long trip.



The motorcycle-raft can sustain great weight so that supplies can be carried for a long trip

Helping the Deaf Mute to Talk in the Dark

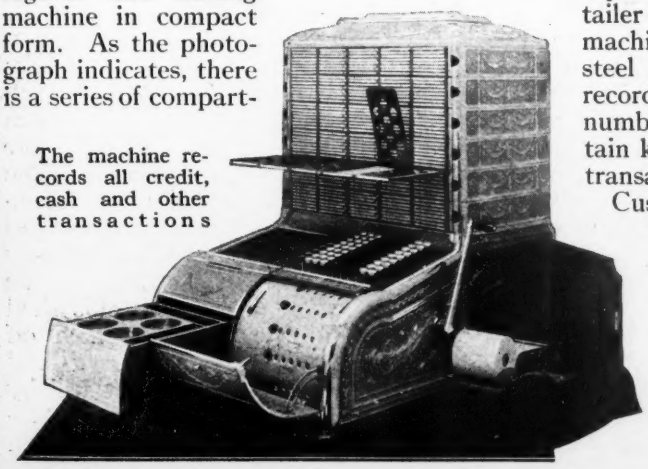
IN THE Court of Domestic Relations, in New York City, a deaf mute couple aired their troubles recently. The man's complaint was that his wife quarreled incessantly and would not allow him any peace until darkness came and he could no longer see her fingers. When asked by the judge why he did not look in another direction, the man replied that the deaf mute's desire for conversation is so great that he cannot tear himself away from such communication, however unpleasant it may be. Anything is better than the silence.

Each finger is fitted with a ring containing a tiny light-bulb operated from the battery by a push-button close to the thumb

Here is an invention that makes it possible for deaf mutes to talk (or quarrel) right on after the lights are out. It consists of tiny electric light bulbs fitted into small rings which fit over the fingers of the deaf mute and enable him to talk in the dark. A small battery fits across the palm of the hand and is operated by means of a push-button switch convenient to the thumb. The connections extending from the finger-rings to the battery are flexible so that the fingers may bend easily to conceal the lights not in use and to reveal them as desired.

A Machine Which Makes Change and Keeps the Books

WHAT might be described as an automatic bookkeeper is a new device which combines the cash register, credit register and adding machine in compact form. As the photograph indicates, there is a series of compartments set above the keyboard of the machine, each of which contains a credit customer's account. This part of the device is built on the unit system so that it can be added to as the business expands and new accounts are opened.



The machine records all credit, cash and other transactions

In a credit transaction the clerk must make a record of certain details by operating the keys before the credit compartment of a customer can be unlocked. When the handle is pulled forward, this compartment is automatically locked, and a complete and permanent record is printed upon the detail strip.

Provisions are made by this device to record all credit, cash and supplementary transactions. It is said to simplify and expedite the accounting system of a retailer who does a credit business. The machine contains five totaling devices, steel type, ribbon and detail strip to record all business. Each clerk has a number or initial corresponding to certain keys to identify him in each of his transactions.

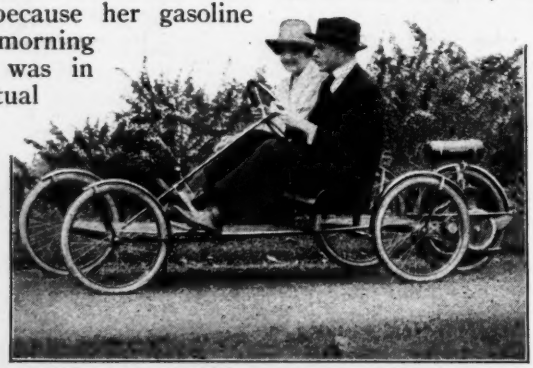
Customers' credit accounts are also indicated by certain numbered keys; this key number also serves to establish their identity. At the end of the day's business the totals shown on the five totaling devices are transformed automatically to the detail strip and a permanent record is thus obtained of each transaction.

Photo by Central News

With her obsolete type of Curtiss biplane (called a "pusher") Miss Law covered a distance of five hundred and ninety miles in nine hours, making the world sit up and take notice

A New World's Record for Continuous Flight Made by Ruth Law

RUTH LAW, a daring young woman of twenty-eight, has two new flying records to her credit—the American cross-country and non-stop record, and the world's record for continuous flight for women pilots. In a two-year-old, now obsolete type of Curtiss biplane she flew from Chicago to Hornell, N. Y., a distance of five hundred and ninety miles, at the rate of one hundred and three miles an hour. She landed because her gasoline gave out. The next morning at nine o'clock she was in New York. Her actual flying time was under nine hours. It takes the fastest express trains twenty hours to make the trip. Until she made her record achievement Miss Law had never flown a greater distance cross-country than twenty-five miles.



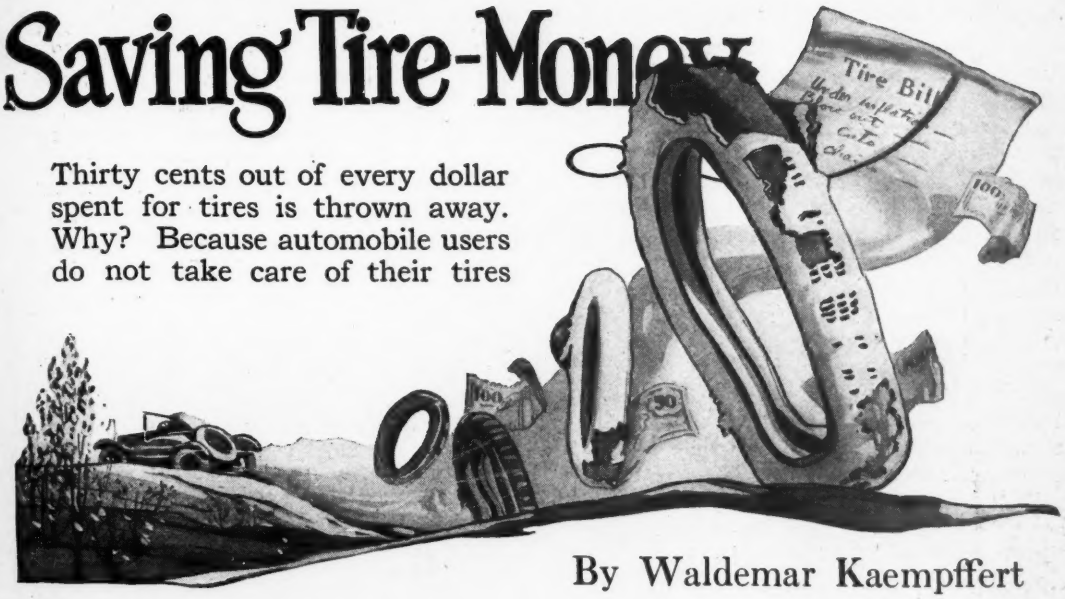
This little buckboard flyer covered ninety miles of rough country road in two hours. Note the motor-wheel attached at the rear

Call This a Boy's Toy or a Junior Runabout, As You Please

THE newest thing in motor-vehicles is the speedy-looking craft in the illustration. It is a light but sturdy buckboard. Motive power is furnished by a motor-wheel attached at the rear. The entire machine weighs only one hundred and thirty-five pounds, and it will cover from eighty to ninety miles on one gallon of gasoline. The control is simple, comprising as it does merely one small thumb-lever attached to the rim of the steering-wheel. A clutch and foot-brake are provided, and the steering arrangement is the same as that of an ordinary automobile. The drive-wheel is lifted about an inch off the ground and released at will by means of the clutch. It is cranked by hand.

Saving Tire-Money

Thirty cents out of every dollar spent for tires is thrown away. Why? Because automobile users do not take care of their tires



By Waldemar Kaempffert

AT the end of 1916 about three and one-half million pleasure automobiles were in use on the roads of the United States. During the year the owners of these vehicles spent about one hundred dollars each for tire maintenance. It follows that the stupendous sum of three hundred and fifty million dollars is annually spent on the tires of the pleasure cars alone. But much of it is squandered. Ignorance and carelessness are responsible for much waste. Mileage is literally built into a tire. It is the driver's task to obtain that mileage. The manufacturer has provided for everything except human fallibility. That is why thirty per cent of the money annually spent on tires, in other words, about one hundred and five million dollars—money enough to interest even Rockefeller or Carnegie—is thrown away. Much of that princely sum, enough to build half a dozen superdreadnoughts, could be saved by the judicious use of mere air, something that costs nothing. Under-inflation is the cause of far too much tire trouble. Klondike gold miners, enriched overnight, have been known to light cigars with hundred dollar bills and are regarded as horrible examples of reckless prodigality. But what shall be said of the sensible business man who throws away thirty cents out of every dollar that he spends on tires?

Structure of a Tire

1. Plies of Sea Island fabric
2. Extra coating of finest rubber between fabric layers
3. 1/8 inch pure Para rubber cushion layer
4. 3-32 inch breaker strip of Sea Island fabric and high grade rubber
5. 1/8 inch tread, tough, resilient, gripping
6. 1/4 inch side wall of strongest rubber
7. Bead, built into tire for clincher rims

Air Is the Secret of a Tire's Buoyancy

It is not the rubber, not the fabric of a tire that gives it remarkable cushioning properties. It is air—just air. If you doubt this, consider the old-fashioned, iron-tired, wooden buggy-wheel on the road. What happens when it strikes a small stone in the road? It rises over the stone, you say. True. But the horse had to lift the entire load, didn't he? Whenever anything is lifted, work must be performed. Clearly, the horse was wasting power.

What happens when an air-tube strikes a small stone? It is simply forced into the tire momentarily; the air in the tube has been compressed, or rather displaced at point of contact; the wheel did not have to be lifted. Do you understand now that the pneumatic tire owes its cushioning effect to air alone? Rubber is utilized simply because it is the only substance known that is elastic, air-proof and water-proof.

Measure the Load on the Tires

To save tire money you must understand that there is a very definite relation between the air-pressure within the tire and the

load in the car. The load on the front tires and the load on the rear tires is not equal. To secure the greatest service from the tires the air pressure of front and rear wheels cannot be the same.

The first step, then, is to measure the load borne by front and rear wheels. That is done by running first the front wheels of a car on platform scales and noting the weight, and then the rear wheels. The front tires should be inflated to about 15-18 pounds per inch of tire section, and the rear wheels to about 15-20 pounds.

The inflation tables published by all tire manufacturers apply only to unloaded cars. Cars are driven loaded, not empty. The wear on the tires of a light car, when a single extra passenger is carried, is anything but negligible. In a small roadster, equipped with three-inch tires, that third man who always insists on riding with you, even though there is obviously no room for him, increases the load by about forty pounds per tire, which means that the tires are underinflated by that amount so long as he is a passenger.

To make a pneumatic which will carry its proportionate share of a load, which comprising vehicle and passengers, weighs considerably over a ton, for as much as ten thousand miles (the earth, mind you, is only twenty-four thousand miles in circumference) is about as difficult a technical problem as ever a manufacturer solved.

The tread must act as a kind of armor, and yet the tire must be very resilient—two quite incompatible ideals. To obtain elasticity and also resistance to sharp gravel, the tread is made very thick and the sides as thin as is consistent with strength and flexibility, to keep heat at a minimum and so that they may bend and recover their shape as the tire rolls along.

To remedy a small cut in this tire an inside patch was applied, which acted as a wedge, resulting in a blow-out

Note how badly the tread shown below is cut and torn from the use of chains, evidently fastened tightly to the spokes and not soon removed

The Action of a Tire

Energy is lost in bending the rubber in the side walls, but not much, inasmuch as the pressure is constant and the air around the wheel is continuous. Although air is being constantly displaced, the rapidity with which expansion succeeds compression, as the tire revolves, overcomes the effect of this work almost wholly. In the solid tire, work is done by the rubber, the inherent compressibility of the material being constantly tested by repeated compression and expansion and attendant heating.

A tire which is blown up tight is not so yielding a cushion as one which is softer. The higher the air pressure within, the less opportunity have the sides for bending. Hence, the temptation is strong to let out a little air. The car rides more easily. But all the time the side walls bend back and forth, back and forth, thousands and thousands of times. You know what happens when you bend a piece of wire back and forth with your fingers. It becomes hot long before it breaks. The side walls of a

To the right: A casing that is badly rim-cut or broken just above the bead. The flap became misplaced because the tire was improperly applied

Below: A tire worn off by ruts. The same condition results if a tire is run on muddy roads that have a frozen crust through which it sinks, or against the curb

tire cannot bend without heating the interior. After a time the rubber cement that holds the internal structure together, hardens; the layers no longer adhere together; a loud explosion breaks upon the air; it is time to buy a new tire.

Don't Be Afraid of the Sun

Although tires are thus sensitive to heat, it must not be supposed that they are very much affected by the sun on a hot summer day. It is true that heat expands the air within a tire, and that the resultant expansion manifests itself in increased air pressure. But no tire manufacturer makes allowances for the heat of the sun, simply because it is negligible in the life of a tire. At the end of a day's run, with the thermometer over ninety degrees in the shade, the pressure within a tire will never increase six pounds.

Beware of a Little Cut

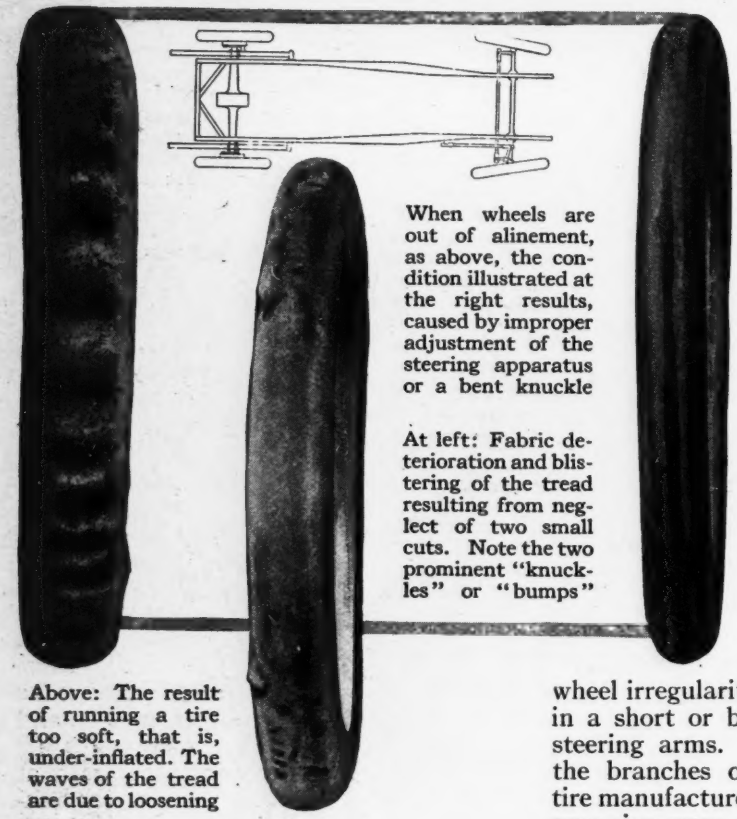
Everyone knows that sharp stones, nails and glass may cut through the tread and cause a puncture. But other causes of punctures are not so self-evident. The lug of a screw-bolt, a tire-removing lever, the inner head edges of the casing, sand, and other hard substances which have worked their way into the casing are equally fruitful causes of punctures.

Out-and-out punctures, however, occur rarely. A tread one-half an inch thick, very tough, backed up by ply after ply of the finest and strongest Sea Island cotton or the stoutest cord, is not easily pierced. It is the little cut, so insignificant apparently, that is more insidious, because it is a less obvious danger. No cut is so small but mud, gravel and dust can be forced into it, and that dirt bores its way into the tread as the wheel turns over hundreds and hundreds of times.

Soon the original cut lengthens and widens. More dirt enters. Finally, the tread is completely pierced, and the dirt begins to wedge the tread away from the inner fabric. Often "boils" appear as the visible evidence of the process of destruction. Then comes the inevitable blowout, followed by the usual arguments with the tire company.

Water has the peculiar faculty of penetrating even the minutest crevices. It is rapidly absorbed by the cotton of the tire fabric. A cut, therefore, is dangerous not simply because it may admit sand or mud, but because it will also permit water to collect. Dampness acts on the fabric of stored tires far more quickly than water on canvas wholly immersed. The fabric is broken down and the casing correspondingly weakened. Often tires will burst after having been stored through the winter.

Much of the expense entailed by blowouts can be saved by treating a cut as sensibly as you would a hand injured by a little splinter. Pick out the tacks, glass and the nails, just as you would the splinter. Wash out the injury, and then fill it with



When wheels are out of alinement, as above, the condition illustrated at the right results, caused by improper adjustment of the steering apparatus or a bent knuckle

At left: Fabric deterioration and blistering of the tread resulting from neglect of two small cuts. Note the two prominent "knuckles" or "bumps"

Above: The result of running a tire too soft, that is, under-inflated. The waves of the tread are due to loosening

one of the many excellent rubber preparations supplied by tire makers and repairmen.

Taking Care of the Inner Tire

The inner tube is the air-container of a tire. Because it is very thin, very elastic, it must be protected by outer casing. It is evident that the casing will fail to act as an armor; that the inner tube will be cut, if pebbles and gravel work their way through an external cut. Cleanliness means tire-money saved.

An inner tube must not be too large or too small. If it is too large it must fold itself to fit the confined space within the casing. The rubber is sure to crack in the creases. On the other hand, if the tube is too small, it must stretch inordinately, which means that it soon loses its liveliness.

Tire manufacturers treat the inside of their casings with a white solution which prevents the tube from sticking to the fabric. Lubrication is always necessary. Talc, powdered mica, and soapstone should be used from time to time. But the lubricant must be applied evenly with a soft rag. Dumped into the case, it will merely collect at one point, where it will heat up and burn the rubber of the tube.

Wheel Irregularities

Wheels that do not track, unevenly tightened clamping-brackets of demountable rims, loose hub-disks, bent axles and bent steering rods, all lead to excessive wear on the tires. The front wheels of most cars are wider than the rear wheels by three-eighths to one-half an inch. A variation greater than this means that the wheels are out of alinement. The cause of wheel irregularities is generally to be found in a short or bent drag-link between the steering arms. Wheels can be tested at the branches of nearly every important tire manufacturer and at any garage. Since excessive wear may also be due to poorly adjusted brake drums or unevenly clamped demountable rims or bent axles and rods, do not content yourself with a mere test for parallelism.

Effect of Brakes

A car weighing over a ton, traveling at forty or fifty miles an hour, has about as much striking energy as a twelve-pound artillery projectile. Some disposition must be made of that energy when a car is stopped suddenly. Tires were not made for that purpose. Apply the brakes suddenly while your automobile is running at high speed and the wheels will lock so that the tires are scraped along the road or pavement. You know what would happen to your trousers if you were scraped along in that way. A tread, thick as it is, can endure much, but it cannot withstand that. It will be ground off, and some of the fabric plies may even be broken. Locked brakes will not stop a car more quickly than brakes rationally applied.

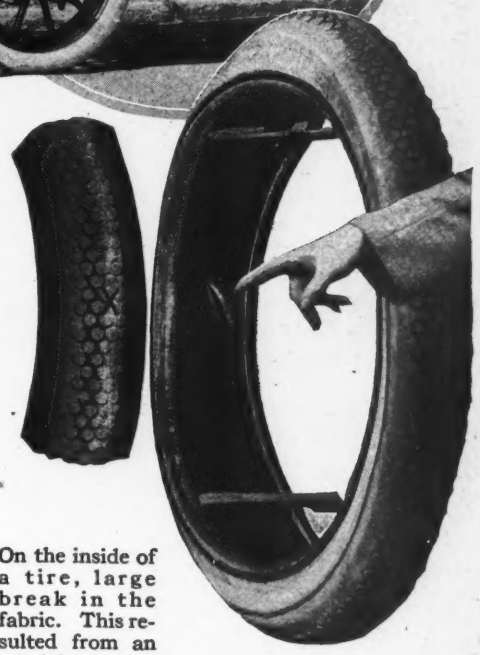
Carelessness in driving against curbstones may wear away the side walls of a tire. If the practice is indulged in too frequently, the fabric will be exposed and the

destruction of the tire hastened. Injuries to the wheel and tires are by no means warranted by the slight advantage gained in point of convenience to passengers.

Rim Cutting

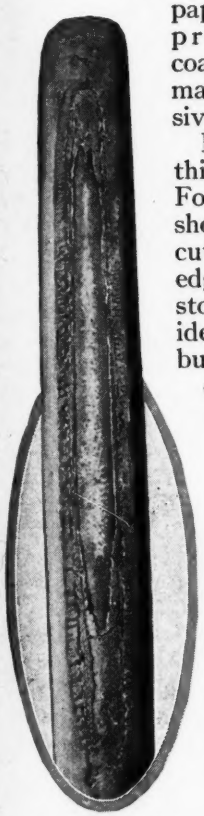
Fifteen, even ten years ago, the beads of rims could cut a soft tire. Nowadays, rims are so ingeniously designed that only a battered section will force itself into the tire. The hooks of a clincher tire may chafe a soft tire because the hooks of the side rings curve in to grasp the bead. Under-inflation is therefore to be avoided. That applies to all tires regardless of type. A blow will bend a rim flange and form a projection which only too easily digs its way into the tire. Since rims are made of steel they rust. Rubber and rust are enemies. A little rubbing with emery paper and a little preservative coating will save many an expensive tire.

Above: How a tire is dented when running over a sharp stone. Just as when you break a stick across your knee, the fibers farthest from the point of contact are the first to give



On the inside of a tire, large break in the fabric. This resulted from an accident, the wheel passing over a stone. Not the slightest mark or indentation on the outside of the case was left (note x in section showing outside). The effect is just the same as if the tire had received a series of hard blows from a big sledge hammer

Because side walls must be thin they are vulnerable. For that reason car tracks should be avoided. The rails cut through the rubber at the edges of the tread. Cobblestones never provided an ideal automobile pavement; but a quarter of a mile of cobble is preferable to a gouged tire.



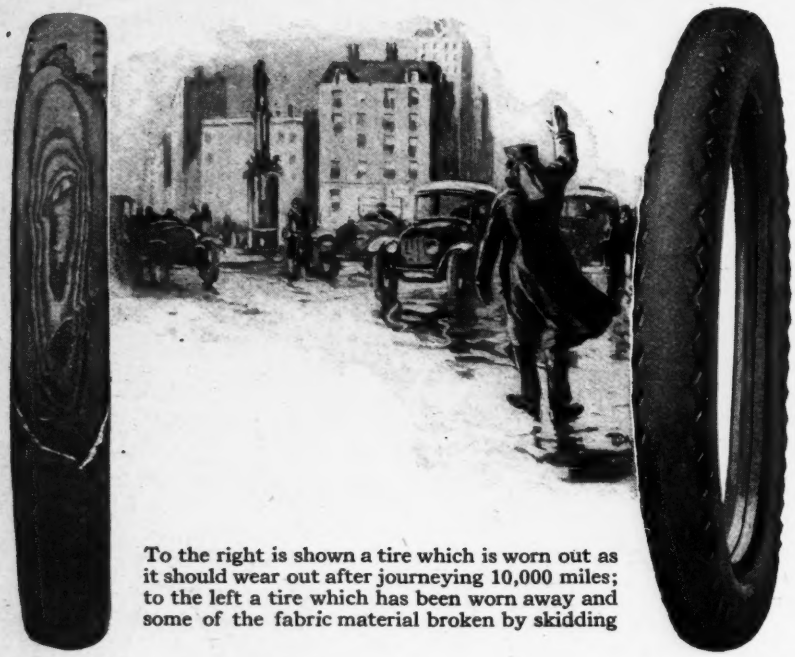
A sudden application of the brakes produced this

Anti-Skid Devices

Anti-skid chains and similar devices are often a necessity. Apply them tightly and forget to remove them, and the tire will show the result in deep cuts. Rubber yields; metal does not. A dull knife will pass through cheese; and a dull chain will cut a tire. Besides, any extra weight causes additional heat, and rubber is very sensitive to heat.

The rubber of a tire suffers chemical deterioration from oil, gasoline or acids. Drop any of these liquids upon a tire and it is just as if you had dropped vitriol upon wood or iron. Wipe away the gasoline or the oil which may have been accidentally spilled upon a tire, and never allow the wheels to stand in puddles of oil on a garage floor or a roadway.

Light has a strong and harmful chemical action upon rubber.



To the right is shown a tire which is worn out as it should wear out after journeying 10,000 miles; to the left a tire which has been worn away and some of the fabric material broken by skidding

What "Balance" Means in a Tire

In order that you may be able to cope adequately and intelligently with the strains and stresses to which a tire is subjected and all the obstacles which it must overcome, the manufacturer has made the tire so that it is, what he calls, well balanced. In other words, he wants it to wear out in all parts at the same time—an ideal which he never quite attains. It would obviously be foolish to provide a tread so excellent that much of it would be left after the carcass had failed. It would be equally foolish to provide side walls which would outlast everything else. To balance a tire, experience is necessary. Defect after defect is removed as it appears. Ultimately, a tire is obtained which, if handled properly, will wear out uniformly. Remember that a tire is the most paradoxical construction in the entire field of automobile engineering. It seems ridiculous to use a substance which is so tender as rubber and yet, if we had no air-inflated rubber tire, there would be no modern, luxuriously comfortable automobile. Whatever its defects may be, the rubber tire is an astonishing construction. It must resist the entire air pressure to which it is subjected, the weight of the automobile and its load, the thrust of the motor, the reverse strain set up when the brakes are applied, the blows of thousands of pebbles and obstructions against the inner air, and the transverse forces applied by the act of steering. Above all, it must act as a shock absorber, thereby protecting the engine and other parts of the car so that they may perform their work efficiently, protect the entire structure so that it may ride easily and safely. Despite all the tales that we hear of tire costs and tire repairs, let it not be forgotten that automobiling as we know it, became possible only because the pneumatic tire was invented.

Will the Beefsteaks of the Future Be a Product of the Sea?

CONSIDERING the rapidly decreasing acerage which commerce and agriculture allow to pasture lands together with the soaring prices of almost every kind of food, it does not require a very fertile imagination to conceive of a time when meat will be a luxury for the table of crowned heads and uncrowned capitalists, unless the ever-resourceful commoner, seized with a realization that three-fourths of the surface of the earth is water and practically a waste as far as production of varieties of diet are concerned, should re-discover that the mammals of the sea are worthy of cultivation as food.

It is estimated that the meat of one sixty-foot whale, for instance, is equal to that of seventy head of cattle and tastes like choicest beefsteak in flavor, when properly prepared.

Other marine mammals which are good for food as well as for commercial purposes are the seal, the walrus, the dugong and the sea cow. The dugong has always been prized for food by Asiatics, Africans and Australians, and the sea cow formerly found in the waters of the Bering Sea, was so noted for the palatableness of its flesh, its size and for its gentle fearlessness of man that it has been almost entirely exterminated through man's greed.

The Problem of the Sloping Shoulder Solved with a Plumb-Line

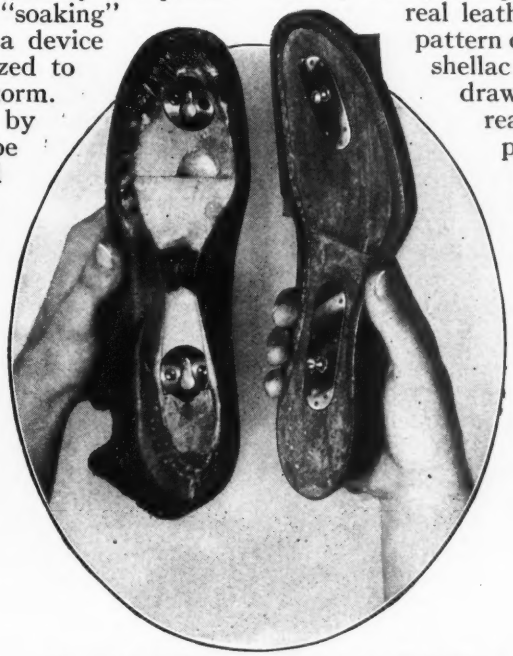
TAILORS admit that the sloping shoulder presents a problem. To solve that problem an Indiana tailor has invented a contrivance of astonishing simplicity.

An angle-shaped piece of steel is fitted against your shoulder. A plumb-line is suspended from the upper branch of the piece. When the lower branch is pressed down snugly against the shoulder, the bob will be displaced along the lower branch. Lines are marked on the lower branch and by reading the figures on the line opposite which the bob stops the angle at which the shoulder slopes is instantly obtained.

The angle-shaped piece of steel is made to indicate the degree of the slope

A Friend of the Traveling Shoe Salesman Must Have Invented This

THE illustration on the right seems to depict the dire extremity of a pedestrian caught out in a "soaking" rain; but it is really a device which might be utilized to advantage in such a storm. It is an arrangement by which the sole of a shoe may be detached and another substituted without spoiling the appearance of the shoe. Where the traveling salesman of shoes has many sample styles to carry, the weight of his stock becomes a feature to reckon with. But with this device he need carry only one upper and various soles, equipped with the screweye and socket plates as shown in the picture. The plates may be used by the layman also.



Two sets of plates having screweyes fitted to sockets are attached to the shoe, one set being at the heel and the other at the toe

Making Imitation Leather from Paper Preparations

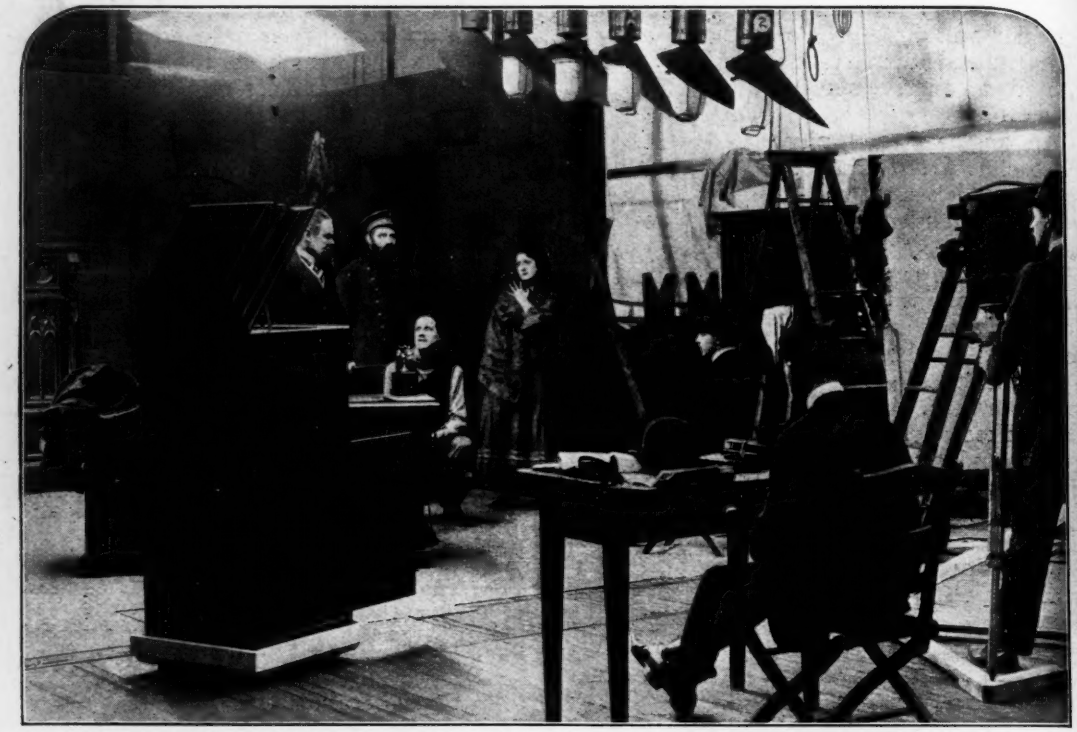
A GERMAN firm has succeeded in producing from paper pulp an imitation leather, which is to all appearances and for specific purposes as attractive as the real article. Long-fibered paper of the necessary thickness is used as the foundation. This is reduced to pulp and tinted, glycerin being added to the coloring substance to give greater flexibility to the paper. After this it is made water-proof by a treatment with a weak solution of borax or of shellac in wood alcohol. To get the actual appearance of leather, a piece of morocco or other real leather of beautiful grain is selected for use in making the matrices in which the artificial product will be pressed.

The impression of the grain is made by coating a cast-iron plate with shellac liquefied by heat, and pressing against it the real leather which is to be the pattern of the grain. When the shellac is cold the leather is drawn off and the matrix is ready for impressing the previously prepared paper mass. After the graining, the sheets are lacquered and varnished.

Another German manufacturer has a plan for rendering the paper-leather soft and pliable. He passes it through a bath of glycerin mixed with nondrying oils, such as castor oil, before subjecting it to the final wet press.

There are other similar inventions, so that leather from paper may soon be a common commodity.

Using a Phonograph and a Man-Made Hurricane



Who ever thought that the phonograph would inspire a motion-picture actress? And yet phonographs are now used to assist a player to evoke the particular mood called for by the producer

Inspiring Motion-Picture Actors by Means of the Phonograph

PICTURE the sweet country maid of a motion-picture studio dreaming of her lover in a far-off land. The director shouts at her: "Look wistful, longing, melancholy —what you will." He bellows: "Go!" which is the signal for action. A talking-machine—yes, a real talking-machine—is started, and the strains of "I Hear You Calling Me" are heard.

"You see," says the director, "the important part that the talking-machine can be made to play in the production of a motion picture. In the course of time directors will realize that the talking-machine can play the part of 'assistant director.' It is certainly an invaluable aid in creating emotions. We in the studio have come to regard it as indispensable. The actor may not know the whole story of the film. It is difficult for him to come in 'cold', and, at a given cue, work himself into the correct emotional state for a realistic and convincing portrayal. Here is where the talking-machine comes to our aid.

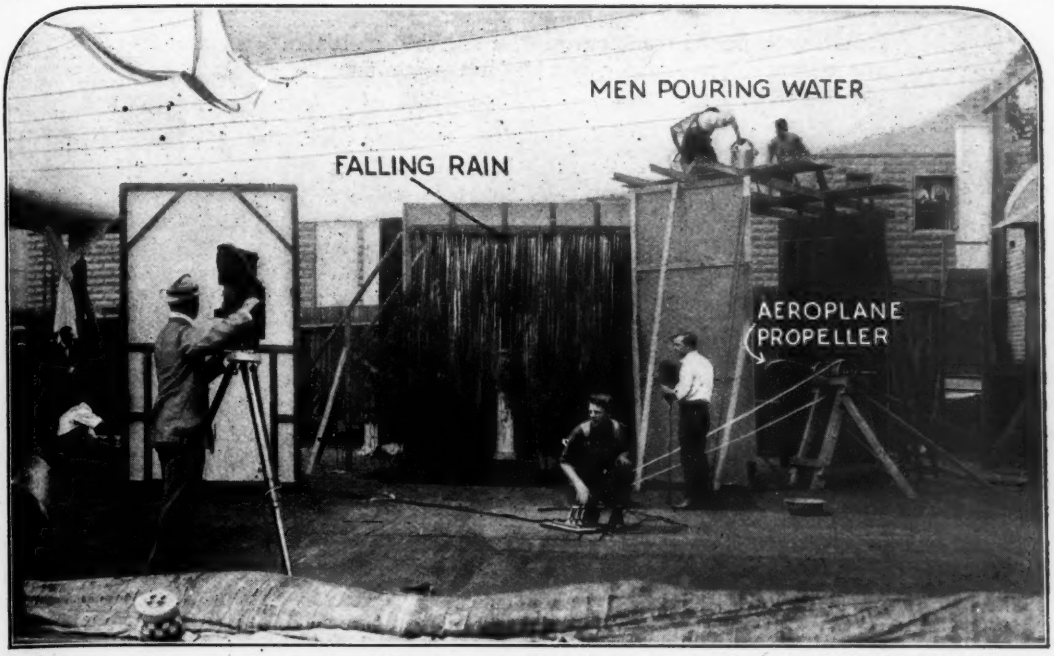
"We know how music enhances the effect of the motion picture as presented in the theater. The audience does not often realize the importance of the musical accompaniment. But, omit the music, and the difference is felt in a moment. The effect that music has upon the spectator is analogous to its effect upon the actor. He responds readily to the musical stimulus."

How Motion-Picture Statues Are Made Overnight

ONE of the large motion-picture producing companies need depend no longer on outside assistance for its statues, papier-maché figures and the various artistic accessories which make up a modern thriller. This company has a special art department with twenty-five men engaged in papier-maché and composition work.

In the process of making models from clay, the first step is to provide the frame for the clay, which is molded into the desired form by hand. From this clay model a glue mold is made and into this is poured plaster of Paris. When it is dry the glue is removed, leaving the cast of the statue, goblin, or what not, finished.

to Produce a Thrilling Celluloid Melodrama



The aeroplane propeller (at the right) produces a hurricane, which drives the "rain" (supplied by buckets of water from above) against the foliage. Thus is a terrible motion-picture storm produced

Making Storms to Order for Motion-Pictures

NO, the poor little rich motion-picture stars do not have to wait months until a hurricane comes their way before they can appear in one of those thrilling celluloid thunder-storms. All they have to do is to don their waterproofs and then step on the stage where the director has a ready-made storm waiting for them. The accompanying illustration reveals the secret.

The camera-man stands ready to take the scene. At the right is an aeroplane propeller. It produces a little hurricane. The stage-hand in the foreground is at the switch, ready to start the propeller at a signal from the director. On a scaffold over the propeller and to the right of the "set" are two men pouring water on a trough which leads to the "set."

Behind the screen at the left is an apparatus to produce flashes of "lightning." Here also is a man holding a string attached to the vase supported upon the pedestal in the "set." At the signal, the propeller revolves, driving the rain against the foliage; the flashlight is touched off, and the man pulls the string attached to the vase, causing it to crash to the floor, just as if a bolt of lightning had struck it.

Avoiding Eye-Strain in Watching Motion-Pictures

MANY persons cannot attend motion-pictures because of the annoying after-effects on the eyes. Some suffer from eye-strain and others are subject to severe headaches. The relief, in most cases, consists in perfectly fitted glasses. The picture may not be quite so sharp, but this is more than compensated for by the increased comfort. For persons with very sensitive eyes, a colored glass, either amber, yellowish green or amethyst, may afford immediate relief. Several varieties of colored glass have been put on the market recently, and there are so many shades available that some suitable color can be secured. A subdued light in the theater has a much less irritating effect than a dark theater where the only light is reflected from the screen. It is also advisable for those who are liable to suffer after viewing the pictures to avoid sitting in a place where it is necessary to look upward, as the additional strain becomes very tiresome, and frequently leaves a severe headache. In the majority of cases, however, if glasses are correctly fitted to a person, he or she stands a good chance of enjoying motion-pictures without any attendant ill results.

A Wooden Boulevard Over the Desert

Building a board road across the shifting sands of a western desert to provide a thoroughfare for the automobile

WHATEVER may be the mystical charm of a desert, with its great golden stretches, its silences and mirages, it certainly is not conducive to "big business" except to writers of romance and to camel-breeders. In the United States a desert is simply a bad place on the route that must be traversed, and as such places mean inconvenience and delay, they would have to be covered with something having a more valuable glitter than sand to have any hold on popular regard.

Between the imperial irrigation district and Yuma, Arizona, the sand is so fine and dry that when a handful is picked up, it trickles out of the closed fist like the grains in an hour glass. Imagine, then, the difficulty of traveling over this country in a heavy vehicle, and especially in an automobile. But the significant fact is that the state highway runs through fifty miles of such sand.

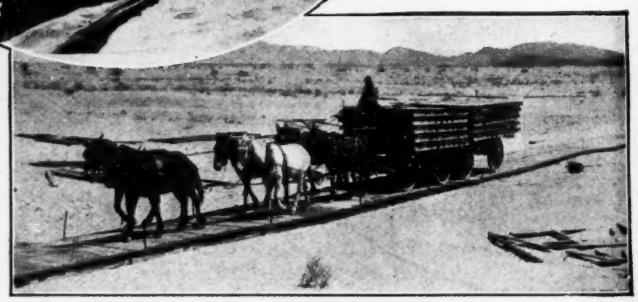
Until the California Highway Commission found a way to combat the sand, it was risky for an automobile to travel over this dangerous route. Six miles of portable plank roadway have now been constructed through the worst sections of this desert. This roadway, eight feet wide, with double-width turnouts every one thousand feet, consists of four-inch planks solidly spiked to stringers underneath, steel strips one and one-half inches wide by one-fourth inch thick, one-half inch carriage bolts, and nuts and washers to unite the stringers.

An overhead tramway was utilized to handle the lumber to build the roadway. Several hundred feet of trolley with triplex chain blocks were provided to pick up the completed units, built on three construction tables in the lumber yard, and later to load them on the wagons for hauling to the work. Ten-horse teams were often used. Each load contained nine units, and the average haul was seven miles.

The venture has proved a complete success.

Above: The kind of truck used to haul the track sections from the lumber yards to their destination

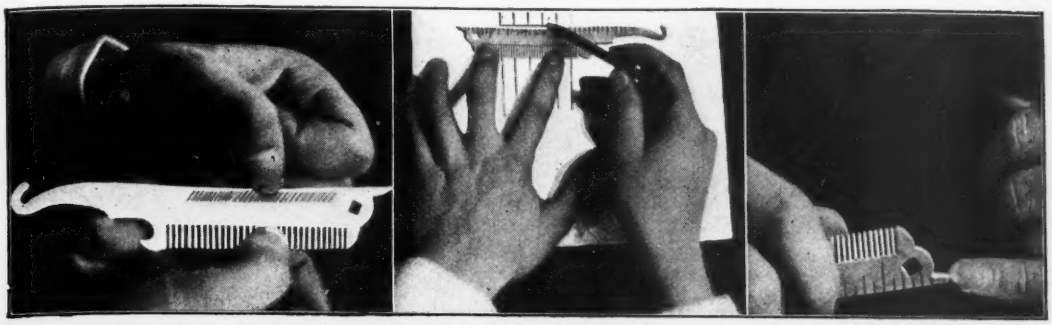
A light plank road was previously used, but as the sand was constantly shifting such a road was almost as dangerous as none at all. It was soon seen that if automobiles were to be used the roadway must be stabilized



The venture has turned out successfully. Heavy loads drawn by any number of teams, as well as automobiles may now cross the desert with comparative ease

The Versatility of a Pocket Comb

It rivals an acrobat in the number of things it can do



As a toilet accessory the comb takes the place of a nail file and an orange wood stick for cleaning the nails. In the center picture it is shown used as a six-inch rule

Above: No need to hunt around for a buttonhook if this comb is in your vest pocket. It is provided with a hooked end which will answer the purpose to perfection. It will also open the beer bottle or the envelope with equal ease

On the left is a photograph of the inventor, F. O. von Tobel, showing that the versatility of the comb has not robbed it of its original hair-smoothing ability. Other uses for the comb are numerous and easily discoverable by the owner of the treasure

UNDER the ingenious care of an inventor the ordinary pocket comb has developed into a combination tool with nine known uses and any number of unknown ones. It can open bottles and letters, button your shoes, measure and rule lines, clean your fingernails and file them, turn on the automobile lights, take the place of a compass, and finally, comb your hair just as well as it ever did before its nine-sided usefulness was discovered.

The inventor is F. O. von Tobel, of New York. When the tool is used as a compass one end is attached to a board and a pencil is inserted in the buttonhook end. The pencil is then moved and circles are drawn. The tool is marked off in a scale six inches long. The nail file is directly above the teeth, on the under side of the scale.

Scrubbing Brushes by the Mile for Cleaning Locomotives

THE six-ton industrial locomotives of a Western railroad often come in to the inspectors for repairs and a general cleaning. To get the rough grease knocked off, a novel scheme has been devised.

A side track about four hundred feet long has been unused for a long time, and on this there has sprung up a dense growth of woody stalked weeds.

When the engine is run slowly back and forth over this natural tooth-brush, the stalks slap around among the rods like long withes. Wind and rain soon clean up and restore the damaged brush and new weeds are always growing. Thus, while conserving natural resources in weeds the railroad is also conserving overalls.

Climbing Out of a Mud Hole

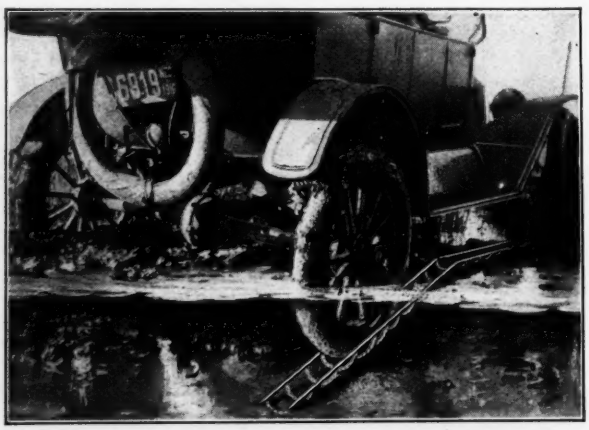
The automobile may use its own engine power to operate a winch

A worm and gear is first connected with the motor crank-shaft to wind a cable on a drum located in front of the radiator. Then the free end of the cable is attached to a stake or tree and the car pulls itself out with little effort

This device is adaptable for all makes of automobiles and also for motor-trucks as a hoist in loading. When not in use the worm is taken out and stored in the tool box, leaving the automobile front free and unmarred

ANY automobile which runs its nose into a mud-hole and which has no special means of pulling itself out is in a sorry plight indeed. But the automobiles equipped with the devices shown in the accompanying illustrations have nothing to fear from the worst of holes. Each of the appliances provides a simple means for getting the automobiles to "grip," but one of them is for attaching to trees and the like, while the other is for marshy places where there are no trees.

In the one case, a worm-gear is fitted between ball-bearings on the crank-shaft. Meshing with this is another gear which is rigidly attached to a drum-shaft mounted across the front of the automobile. The gears are made in a reducing ratio, so that, when a cable is attached to a tree and wound up on the drum, enough pull is exerted to drag the automobile clear. This method is very much like that used in warping ships into a side berth.

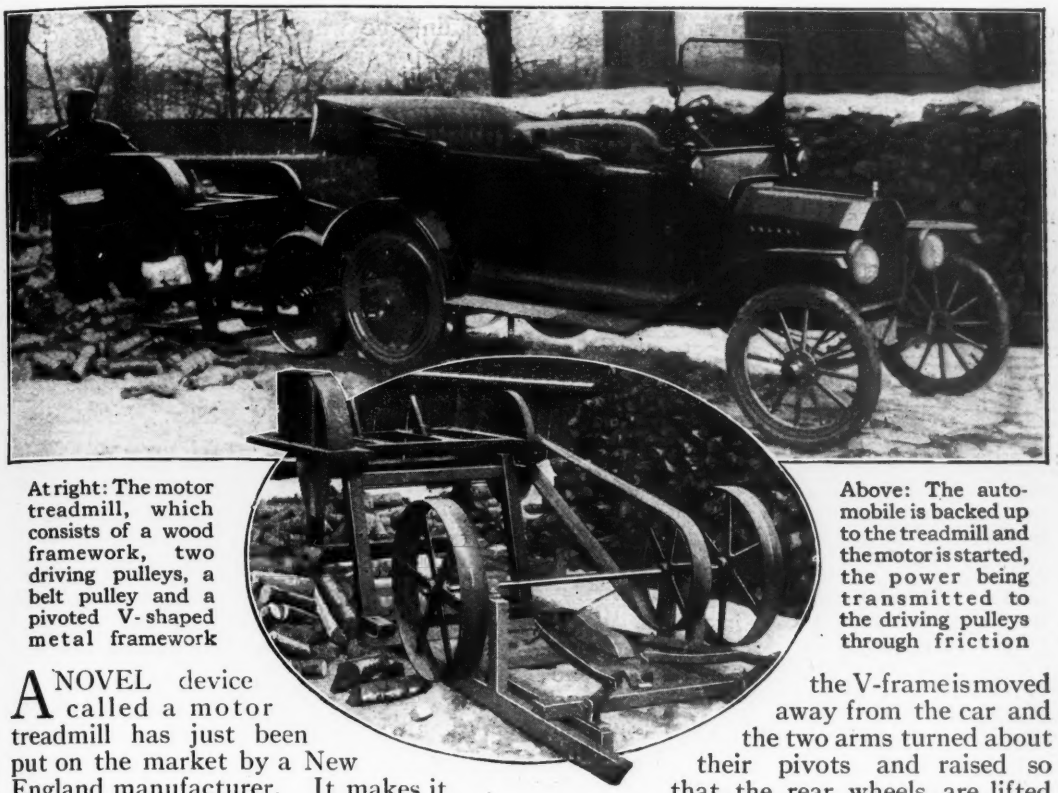


The ladder is thrust under the rear wheel that is mired, clamping the tire and making a track

The other appliance uses two iron side-bars jointed at the middle and across which chain-rungs are attached. One such "ladder" is forced under each driving-wheel, the power is turned on and the car climbs out.

Making the Automobile Do the Chores

How the modern farmer dispenses with numerous farm-hands



Above: The automobile is backed up to the treadmill and the motor is started, the power being transmitted to the driving pulleys through friction

At right: The motor treadmill, which consists of a wood framework, two driving pulleys, a belt pulley and a pivoted V-shaped metal framework

A NOVEL device called a motor treadmill has just been put on the market by a New England manufacturer. It makes it possible for the power of any automobile to be utilized for running a cordwood-saw, threshing-machine, cider-press, cream-separator or butter-making machine.

The device is portable and can be carried by one man. It consists of a wood framework or base, as shown in the accompanying illustrations, two driving-pulleys and a belt-pulley carried on the same shaft, and a pivoted V-shaped metal frame operated by an ordinary screw-jack. The wide end of the V-frame is supported on two flat arms pivoted to the wood base. These arms are provided with two curved lugs at their ends to slip under the automobile's rear axle-housing. The sharp end of the V-shaped frame is slightly flattened to take the head of the screw-jack, the other end of which is stationary against a wood block bolted to one of the members of the wood base.

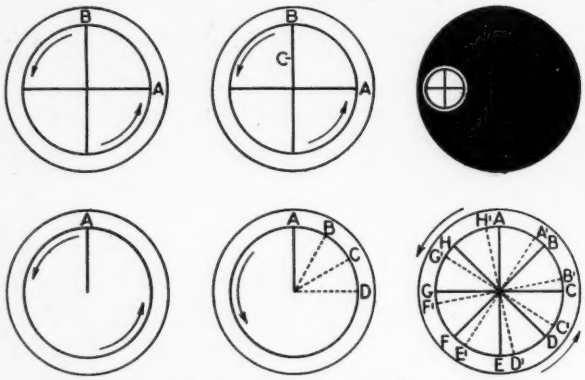
The automobile is backed up to the treadmill, so that the rear wheels are square with the two driving-pulleys, the curved lugs on the V-frame arms being beneath the rear axle. As the jack is screwed out, the V-frame is moved away from the car and the two arms turned about their pivots and raised so that the rear wheels are lifted clear off the ground. As the jack is screwed out further, the tires are brought up against the driving-pulleys, so that the former are slightly depressed at the points of contact on the driving-pulleys, thus giving sufficient traction to prevent the tires from slipping. The automobile-motor is then started, the power being transmitted to the driving-pulley shaft through friction between the revolving rear wheels and the pulleys. The wood saw or other machine is then driven off the pulley-shaft by means of a belt in the usual manner of operation.

No changes are required on the car for use with the device and any make of car can be employed, the differences in tire diameters being taken care of by screwing the jack in or out as required.

In this way the automobile goes up still another notch in importance on the farm. The farmer is no longer entirely dependent upon more or less unreliable "hands" and the work is doubtless done better and in less time than by the old method.

Why Wheels Run Backward on the Motion Picture Screen

WHEN the moving-picture camera takes a picture the film is not exposed continuously. Instead it is uncovered and then covered again in very rapid succession by a black disk edged with a circle of holes which are swiftly rotated across the front of the lens. In this way a series of pictures is taken which represents the successive movements of the subject that is photographed. But because of this very fact, the speed at which an object appears to rotate when the developed film is projected on the screen is very seldom the speed at which it actually rotated.



The speed of rotation of the wheels may be such as to make it appear to stand still as in the top row, or even to be running backward as in the bottom row

Take, for instance, a four-spoked wheel, such as shown in the illustration, where the wheel rotates at a speed such that after one picture of the film is exposed, the spoke *A* has turned around just enough to show *A* at the position of *B* when the next picture is exposed. It is evident that in a case of this kind, if the spoke and the camera keep turning at constant speeds, when the spoke is projected on the screen it will appear to be standing perfectly still.

Again, the wheels on fast moving cars often appear as if they were moving backward while the car is going forward. This would happen if the spoke *A*, shown in the bottom row of the drawings, had been revolving so fast when it was photographed, that during the interval between one exposure and the next, the wheel revolved all the way around from *A* to *B*. When the next exposure was made the spoke appeared at *C*, and so on. When this film is run off and projected on the screen, the spoke will seem to run backward. No matter how many spokes there are on the wheel it is evident that the effect on each one will be the same, and the entire wheel will appear to turn backward at the same speed as that of each spoke. It is merely an optical illusion.

Money Prizes for Motorcyclists

Send In Your Kinks

IF you are a motorcyclist, if you have devised simple ways of making repairs, if you have improved your machine in any way, this will interest you.

The POPULAR SCIENCE MONTHLY offers a first prize of $25, a second prize of $15 and a third prize of $10 for articles in which motorcyclists will describe and illustrate the methods which they have successfully employed for overcoming trouble, for making quick repairs by the roadside or more difficult repairs in the shop, or for making attachments whereby the use of the motorcycle has been broadened.

The three prizes will be awarded by the editors of the POPULAR SCIENCE MONTHLY in the order of merit. What is more, even though your article may not win a prize, the editors may buy it at the usual rates, just because it is so good.

There are no limitations to this prize offer. We don't care for fine phrasing, but we do care for good mechanical ideas. Rough pencil drawings or photographs will do for illustrations.

The following conditions are to be observed:

(1) Articles must be written on one side of the sheet only.
(2) Write your name and address in the upper right-hand corner of the first sheet.
(3) Enclose postage for the return of the manuscript.
(4) Don't send in articles on ideas which have already been published.
(5) Don't send paper ideas—things that you haven't actually done yourself.
(6) Address the envelopes containing articles to

"MOTORCYCLE CONTEST EDITOR"
POPULAR SCIENCE MONTHLY
239 Fourth Ave., ***New York City***

The contest will close on December 31st, 1916.

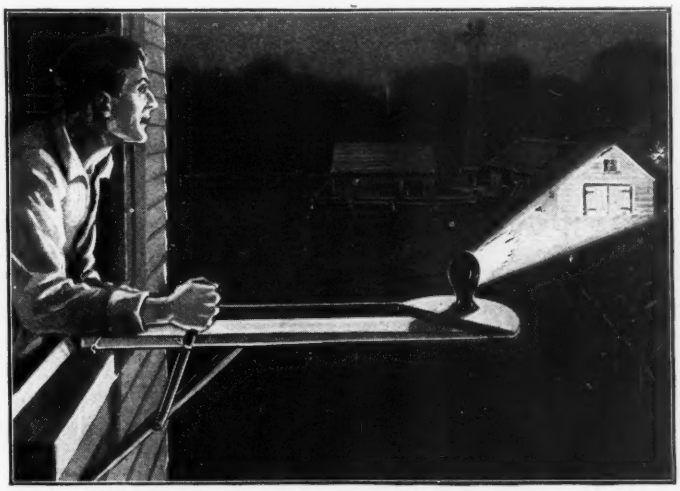
The money for the prizes will be paid promptly after the awards have been made.

FOR PRACTICAL WORKERS

A Small Backyard Searchlight Operated from a Window

IN most suburban towns the houses are well lighted in front by street lights and porch lights, but usually the rear is dark and in shadow. It frequently occurs that strangers and tramps prowl around—looking for a place to sleep and sometimes looking for an occasional chicken. They may even go prospecting to see how easily a house or barn can be broken into. A small but efficient searchlight can be very cheaply made—provided one has electricity on the premises.

A small wooden bracket with a base 2 in. wide and 1 in. thick having a quadrant bolted at the end is fastened to the side of the window as shown. On this is fastened an electric-light socket with a metal reflector painted white inside and green outside. This is connected and adjusted as shown by means of screweyes and a cord, and it is so arranged that when the lever is pushed forward the light turns to the left, and when drawn backward it swings to the right. The current is turned on from the inside by a key socket. If desired the cords may be brought inside and the lever so arranged that instead of pushing forward and backward it is thrown to the right or left, to operate the light.



The swinging of the electric lamp directs the rays to every part of the yard within its scope

The bracket can be tilted downward if the light is set high on the house, so that the light rays will sweep the entire ground. A 45-watt lamp will throw sufficient light 100 or more feet. The quadrant is the only thing that needs particular construction and it is best made of three pieces of ½-in. board in the shape of the letter D. Two are the same size, about 10 in. long on the base of the arc and 6 in. the narrow way. The third piece is of the same shape but about ½-in. smaller all around. These should be placed with the small piece between the two larger pieces so as to form a groove for the cord. There should be but one staple fastening the cord in the center of the outside curved part. The arrangement pictured will sweep through an arc of 180 deg., but if the bracket is placed on a corner, it can be made to sweep two sides of the house or through an arc of 270 deg. by simply crossing the cords and widening the distance between screw-eyes.

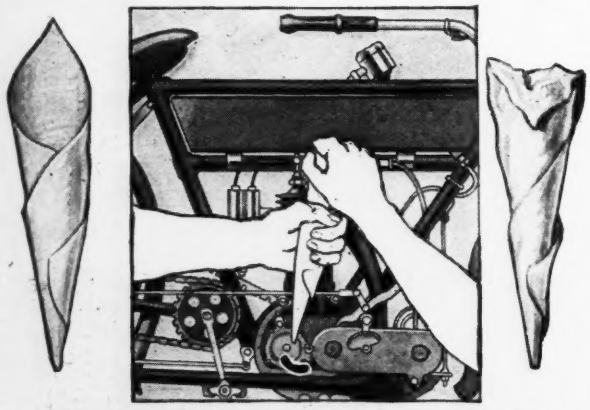
If the electric wire is given enough play, that is, if it is left swinging with one attachment near the house, there will be no fear of loosening the connections.—RONALD F. RIBLET.

A Mixture for Cleaning the Lighter Colors of Paint

A CLEANER for white paint, linoleum and parquetry floors may be made as follows: Boil together ½ oz. of white soap in ½ pt. of water. Add ½ pt. of turpentine to the soap and water, thoroughly stirring it.

Paper Funnel for Use in Place of a Grease-Gun

WHEN the motorist is in need of a grease-gun and one of the regular instruments is not at hand, a good substitute may be made of a paper funnel. Simply roll up a piece of tough paper—heavy wrapping paper will do—into a cone, fill with grease, turn over the upper end and begin to roll. It is like squeezing preparations from a soft metal tube of the variety in which pastes and medicated vaseline are sold, the grease being forced out through the smaller end and into the casing.—R. F. POHLE.



A paper cone as a substitute for a grease-gun for forcing grease into gear-casings of an automobile

A Heat Regulating Device for the Furnace

TO have the house warm and comfortable when you get up, be sure to bank the fire at night. This is made easy by seeing that there is a good bed of coals in the fire box before retiring.

Throw on a few shovels of coal, enough to last far into the morning, and do not entirely cover up all the live coals. Leave a spot the size of your two hands, burning brightly. Now on top of the fresh coal apply a coat of ashes. This is the method by which night firemen hold the heat in large buildings and are able to leave it, knowing the heat will be retained and that it will be easy to quickly get the normal temperature again.

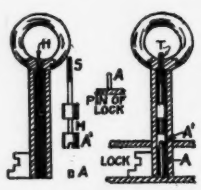
Pull up the check draft, close all others, and set an alarm clock for the time you wish to start up the fire, winding it only twice around, and placing it on any convenient box or stand near the chain-holder. Transfer the ring from the usual hook to the winder of the alarm clock, hooking it just over the corner of the winder, so that when the alarm starts the hook slides off and closes the check draft. The fire will start, and by the time you get up the room will be warm.

If you want to get up at 6 o'clock, set the alarm at 5. If the alarm annoys any one, it can be muffled. Before leaving for the office, rake off the top crust of the ashes, removing all clinkers; see that the draft is open long enough to insure a fresh bed of live coals, and apply coal sufficient to keep the fire until noon.

While the lower draft is open, remove ashes, sprinkling them as they are removed to keep the dust from sifting to the upper rooms.—WILL CHAPEL.

A Key Indicator to Tell When a Door is Locked

THIS device is fitted to a key in order to indicate whether a door has been locked or not. Within the key is fitted a small cylindrical metal piece *M* which can rotate inside. Its upper end has a screw-thread *S*. This piece works in the small threaded hole *H*, and can project out at the top. At the bottom is a slotted part *A*, which lies well within the key-barrel. On the other hand, the lock commonly carries a small rod that fits into the key-barrel when the key is inserted in the keyhole, in order to guide the key. All that is needed is to file a square end on the rod *A* so that when the key is inserted in the lock the square end of the rod acts as a screwdriver on the cylinder within the key-barrel. Supposing that the key is given two turns, as is usual with safety locks, the screwing action causes the small tip to rise out of the hole *H* and project above the key at *T*, where it can be felt with the finger, showing that the key has been used in the lock. On unlocking the door the tip immediately disappears inside.—F. P. MANN.



If the door is locked a projection is felt

Puzzling Tricks with Paper

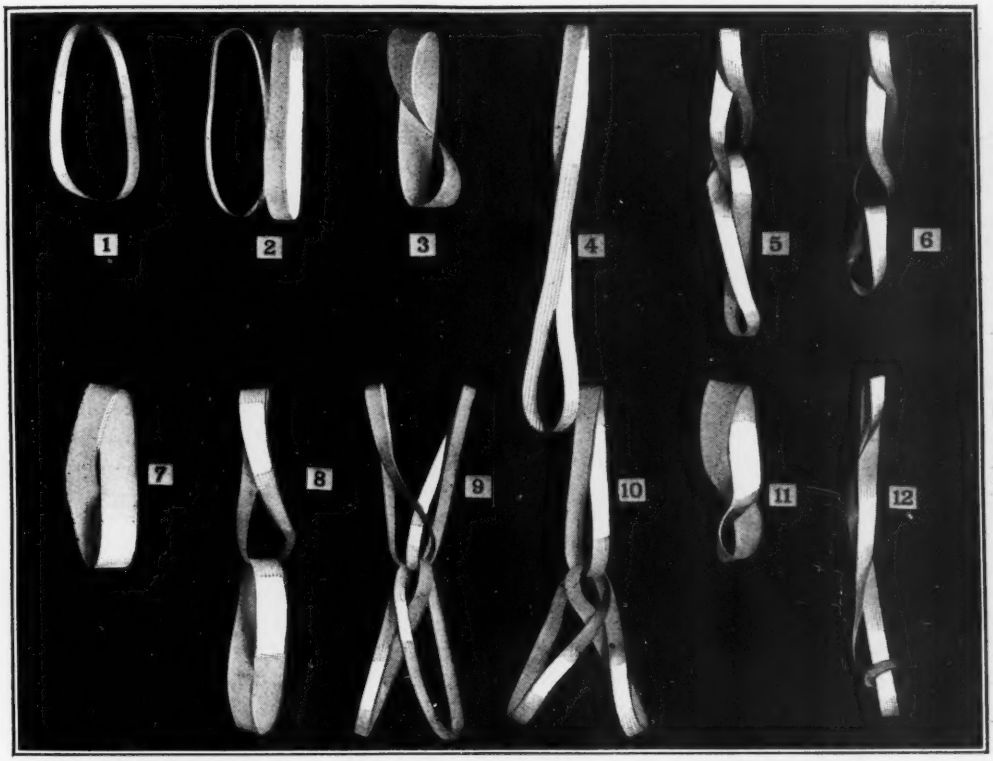
If you would like to indulge in some mental gymnastics, just try this with a slip of paper

A RECTANGULAR piece of paper has two faces or surfaces and four edges. Can you fold such a piece, say 1 in. wide and 12 in. long, so that it will have only one surface and one edge? At first thought it seems to be an impossibility. Yet the solution of the problem is easy and leads up to an interesting and fascinating study of paper folding and cutting.

As a preliminary exercise overlap the two ends of a strip of paper and paste them together to form a cylindrical surface similar to a napkin ring. It has two surfaces now, an inner and an outer, but only two edges in place of four as in the first place. If the ring be cut in two pieces, lengthwise of the paper, two narrow and similar rings will be formed, each having the same circumference as the original.

Take a second strip of paper, place it flat on the table, give one end a half turn and paste the two ends together. A twisted ring or band will be the result. How many surfaces has it? Begin at some marked point and follow the surface. Soon you will return to the starting point, having gone over the entire surface. It has but one surface. In a similar manner trace your way around the edge, and you will be astonished to find that it has one continuous edge. The problem is solved.

Experiment with this twisted ring still further and see what remarkable results you can obtain. With a pair of scissors cut this ring in two parts as you did the plain ring, and, astonishing to relate, the result will be not two rings but, instead, one ring having twice the circumference of the original. From



Various ways of cutting and pasting up a piece of paper to reduce the number of surfaces and edges and to form links of a chain fastened together

this you would probably jump to the conclusion that if this larger ring should again be bisected lengthwise a single ring with circumference again doubled would be formed. Attempt to prove your prediction and you will discover that two rings with the same circumference as the bisected ring will be formed and these two rings will be doubly linked together. Why were the results so dissimilar? This is the explanation. The original paper was twisted one half a turn before the ends were pasted together. After the ring was bisected and the larger ring had been formed, a careful examination of it would have shown that the effect was the same as though it had been formed from a strip one end of which had been given two complete revolutions before being pasted to the other end. This accounts for the difference in the results.

At this point you will begin to wonder what the results would be if the ring should be divided into three parts instead of two, or what difference it would make if the paper should be given two or three or four half turns. Also you will probably be convinced that it would be useless to predict results and that only by original investigation would you be able to arrive at correct conclusions. Here are a few of the cases which you might investigate.

Prepare another ring by twisting the paper one half turn, and separate it lengthwise into three parts of approximately equal width. The result will be two rings linked together, one having the same circumference as the original, the other having twice that circumference.

The next step would probably be to form a ring by twisting the strip two half turns or one complete revolution. This ring, you will find, has two surfaces and two edges. Bisecting it will give two rings linked together. Bisecting each of the two will give a total of four rings arranged in two pairs, the pairs being linked together and each individual also being linked to its mate.

A ring formed with three half turns will, upon being bisected, form a single ring with the circumference doubled, but in the ring there will be tied a simple knot. Bisecting again will give two rings, with the same circumference as at first, knotted as the parent ring and doubly linked together.

In a similar manner the experiments may be continued almost indefinitely until the rings become so complicated that they cannot be handled successfully. If a strip of paper is to be twisted several times in forming a ring, a long piece should be used, and if the ring is to be cut into several parts the width must be increased accordingly.

When a ring is to be re-bisected it is advisable to mark each half with a pencil in order to help in studying out the relations. Where several rings are linked or knotted together it is sometimes necessary to repeat the experiment several times, first tearing off certain rings next other rings before the complicated results can be understood.

In general it will be found that with one, three, five or any odd number of half turns the rings will have one surface and one edge. When bisected they will form one ring with circumference doubled, and, beginning with the third half turn, the ring will be tied in a knot the complexity of which increases with the number of half turns. If these rings are again bisected a pair will be formed having the same shape and circumference as the original and, in addition, each will be linked to the other.

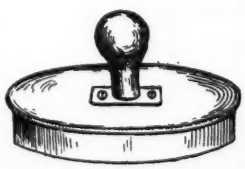
With two, four or any even number of half turns the original rings will have two surfaces and two edges. Upon being bisected two rings will be formed and they will be linked together in an increasingly complicated manner as the number of half turns increases. A second bisection will yield two pairs of rings, each pair having the same circumference and arrangement as the parent ring and, in addition, each ring being linked to its mate.

The trisection of the rings also yields interesting results and opens up new possibilities. To begin with, the manner of cutting into three parts rings formed with an odd number of half turns is different from that used with rings of an even number. The former, it will be remembered, have but one edge. Hence, to trisect such a ring, begin by cutting off a strip one third the width of the original. Continuing the cut, you will make two complete revolutions, finally coming back to the starting point, and the paper will apparently form a continuous ring. Upon unfolding it you will find two rings linked together, one

having twice the circumference of the other. But the rings formed with an even number of half turns are trisected just as you would trisect any rectangular piece of paper lengthwise. These rings have two edges. Hence, to trisect, cut off one third of the ring parallel to one edge and then another third. On each cut you will make one revolution of the ring, the shears returning to the starting point. The resulting rings, as far as I have investigated them, will be three in number, each linked to its two mates, the complexity increasing as usual with the number of half turns in the original ring.

To continue further with this description would be monotonous. As in any experiment, popular interest centers in the performance itself, so, should you merely read this and pass on you will find it scarcely worth your while. Get a pair of scissors, some wrapping paper, a jar of library paste and try a few of the suggested cases. Start the children on it for a rainy day amusement. Give it to the boy who is wrestling with the theorems of geometry. Perhaps he would become interested in tabulating results and could be induced to give a talk before his class, illustrated by cutting some of the simplest forms. As a means of entertainment or instruction for young or old these experiments are worth while and, once started, they have the merit of possessing a peculiar fascination that invites and encourages original investigation.—F. E. Tuck.

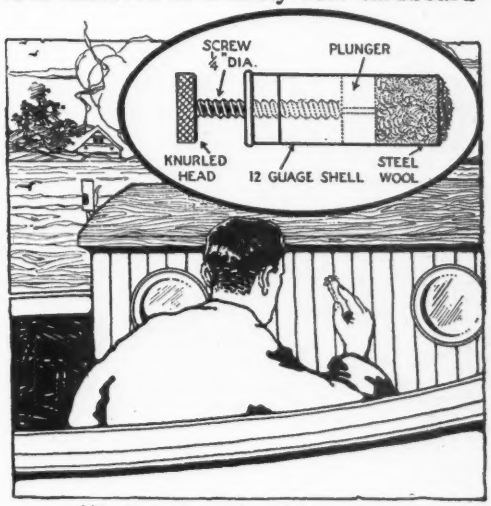
Molding Hamburger Steak with a Can-Cover



HAMBURGER steak, shaped into balls with the hands, never comes to the table in uniform sizes, and there is more than a gambler's chance that the hands of the cook who does the molding may not be absolutely clean. Both of these objections are obviated in the use of a Hamburger-steak cutter made from a can-cover and fitted with a wooden handle—a piece of sheet metal is fastened in the center to strengthen it. A dough-cutter used by bakers in preparing biscuits will also serve the purpose.

Holder for Steel Wool to Protect the Hands

ONE of the objections to using steel wool for cleaning kitchen utensils, such as the bottoms of saucepans, is that particles of the wool are liable to become imbedded in the fingers; but if it is enclosed in a fairly stiff cardboard



The wool is enclosed in a case so that it will not injure the hands

tube, not only will this objection be overcome but a great saving of the wool will result.

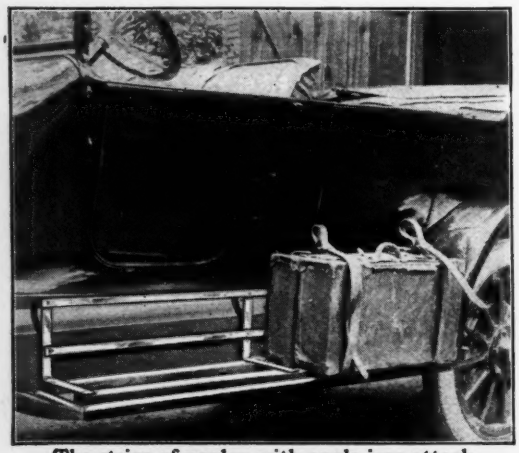
An empty 12-gage shell may be used and filled tight with the wool. This will be found to be a great improvement over holding the wool in the bare hands. The cap and anvil should be driven out from the head of the shell and tapped for a ¼-in. screw with a knurled head. The opposite end of the screw is then fitted with a plunger so that the wool may be pushed out as it is used or rubbed away. A larger tube with a wood end carrying a screw and plunger could be used to advantage.

A Quick Hardener for Patching Holes in Castings

TO fill up holes in castings ordinary filler is not very satisfactory on account of the long time it takes to dry. Sealing or battery wax will be found very good for filling up holes in castings where no strain comes. The wax should be melted into the hole, from the cake, by means of the ordinary soldering iron. The wax hardens immediately and the filler is then applied over it as on the rest of the casting.

Automobile Luggage-Carrier for the Running Board

SOME of the latest models of automobiles do not permit of a luggage-carrier at the rear of the car, and most of the ready-made carriers designed to be used elsewhere on a car are expensive accessories; but the one shown in the illustration is of simple design and construction and is to be attached to the running board. The materials needed for this carrier are 3 pieces of tire-steel, or bar-steel, about ¼ in. thick, 17 in. long and 1¼ in. wide; also 2 pieces of the same thickness ¾-in. wide as long as the running board. The steel is inexpensive and it costs little to have it bent. One strip of poplar wood as long as the running board, 2½ in. wide and ⅞ in. thick; a few screws, rivets and bolts to hold the parts together and ½ pt. of paint will be required.



The strips of poplar with angle-iron attachments for luggage-carrier on running board

The work necessary on the carrier is the drilling of the 24 holes in the steel strips, 2 in the vertical section of each angle-piece and 3 in each of the lengthwise pieces to correspond, the latter being riveted to the former. Four holes are also drilled in the horizontal section of each steel angle, 2 of them countersunk for screws to which the angles are fastened to the poplar strips, and 2 through which ¼-in. stove bolts are passed through the poplar strips and into holes in the running board. The holes in the latter may be new ones or those already bored for other purposes.

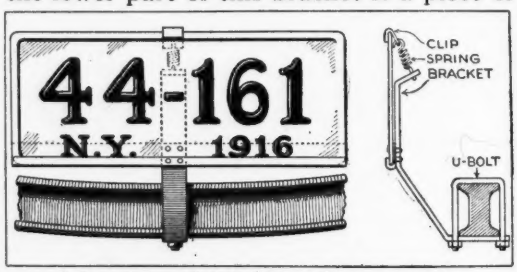
On the undersides of the poplar strips cut out 4 spaces 2 in. wide for the straps to pass through for holding the luggage. The measurements for this carrier should be carefully obtained by finding the exact distance from the inside edge of one of the holes in the running board to the outside edge of the opposite hole, giving the distance from center to center of the holes. There are usually two of these holes at each end of the running board, out of which the bolts must be taken if these holes are to be used instead of boring new ones.

Handy Receptacle for Small Screws and Brads

IN a block 15 in. long, 8 in. wide and 2 in. thick bore 2 rows of holes, 4 holes to the row, to a depth of 1¾ in. If it is desired to have these holes of curved or concave bottom like the old-fashioned money-till, take the piece to a planing mill where they have bits especially for this purpose. A hinged cover should be put on the block with some kind of clasp to keep it securely fastened down when not in use. Eight sizes of brads or small screws may be arranged in this size block as desired. Blocks may be made larger or smaller according to the needs. The convenience of this receptacle is obvious.

A License-Tag Holder for the Front Axle of an Automobile

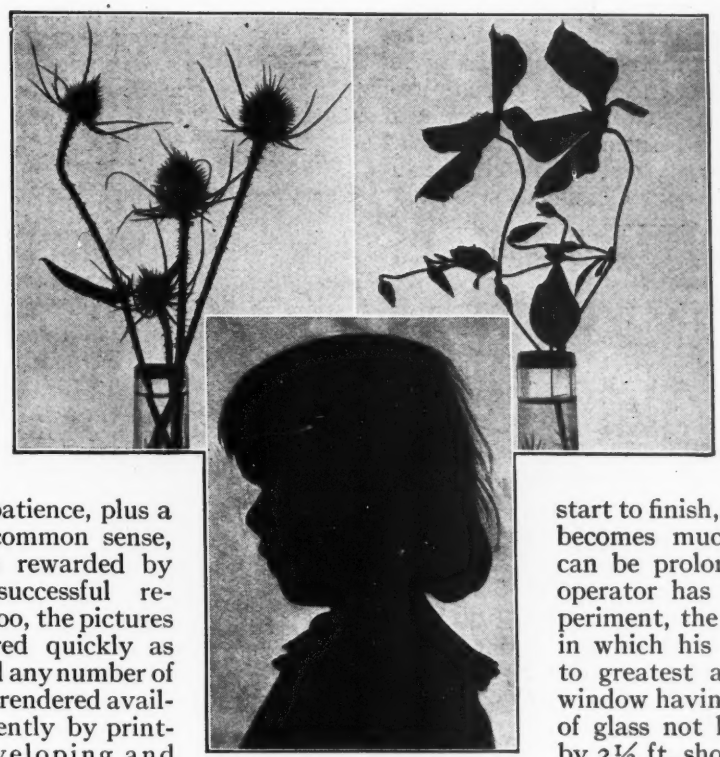
IN states where there is no legal restriction on the height of the front license-tag for an automobile the front axle makes a good place to fasten it, and a good holder for the purpose is illustrated. It is simple in design, may be applied to any I-beam front axle, accommodates any length of tag and allows it to be easily removed and replaced when necessary. It consists of a steel bracket, bent as shown and secured to the axle with a U-bolt. Fastened across the lower part of this bracket is a piece of sheet steel bent up to form a socket for the tag. A clip-and-spring is secured to the upper end of the bracket and when the tag is held down tight in place with this clip the holder for the tag will not be liable to rattle.—W. BURR BENNETT.



A bracket to hold a front license tag for an automobile rigidly and without rattle

The Making of Photographic Silhouettes

THE quaint portraits which our great-grandparents knew and delighted in as "silhouettes" have long since passed out of fashion. But a form of photography showing "shadow photographs" which has recently attracted attention is in many respects a revival of the old-time art. The old-fashioned silhouettes were cut out of paper with scissors, and mounted upon a heavy card, or in some other appropriate way. Certain artists attained such skill that they dispensed entirely with preliminary outlining or sketching. Photographic imitation of silhouettes does not call for much inherent skill on the part of the worker. A little patience, plus a modicum of common sense, will soon be rewarded by charmingly successful results. Then, too, the pictures can be secured quickly as negatives, and any number of copies can be rendered available subsequently by printing out, developing and fixing. Thus, at the time when the portrait is taken, the operator is free to concentrate his undivided attention upon the sitter.



Silhouette photographs of still life and of living models may be made

Shadow or silhouette photographs may be taken either at night or by day. At night, all that is needed is a semi-transparent screen, which can be made from an old linen sheet, or even from paper, supported upon a wood framework. For general purposes the screen should be white, or nearly so, although on occasion a good effect may be gained by employing a screen of neutral tint, or one in which transmitted light reveals a certain graining or irregularity of substance. In other words, the background of the finished picture need not always be dead white, but may be varied in tone to suit the subject. The screen is supported vertically, and the sitter or subject is placed before it. The outline or profile must be very sharply focused; and for this purpose a fairly strong and steady light is needed. But as soon as the focusing is complete, this light must be extinguished. The exposure is then made by burning magnesium ribbon, or a flash lamp, *behind* the screen. If magnesium ribbon is used, about 1 ft. of it should be burnt, the aperture of the lens being left wide open.

On the whole the shadow photographs may be made more satisfactorily by day because artificial light can then be dispensed with from start to finish, while focusing becomes much easier, and can be prolonged until the operator has found, by experiment, the exact position in which his subject shows to greatest advantage. A window having a single pane of glass not less than 2 ft. by 2½ ft. should be chosen. This must not be too high above the floor; if possible it should face north, although this is not essential. To the window-frame a screen of linen or paper may be fixed with tacks or pins. Any transverse light may be shut out by means of blinds or screens. When this has been done, everything will be in readiness. If the day is clear and the light brilliant, a snapshot will be possible; and when children or animals are sitting, this is a great advantage. In dull weather, an exposure of several seconds may be necessary. Everything depends upon the density of the screen that is used.

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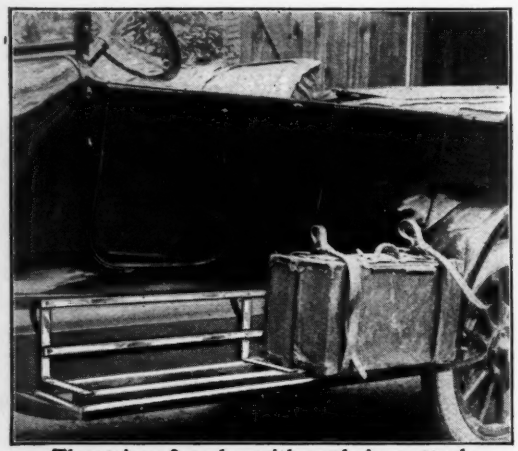

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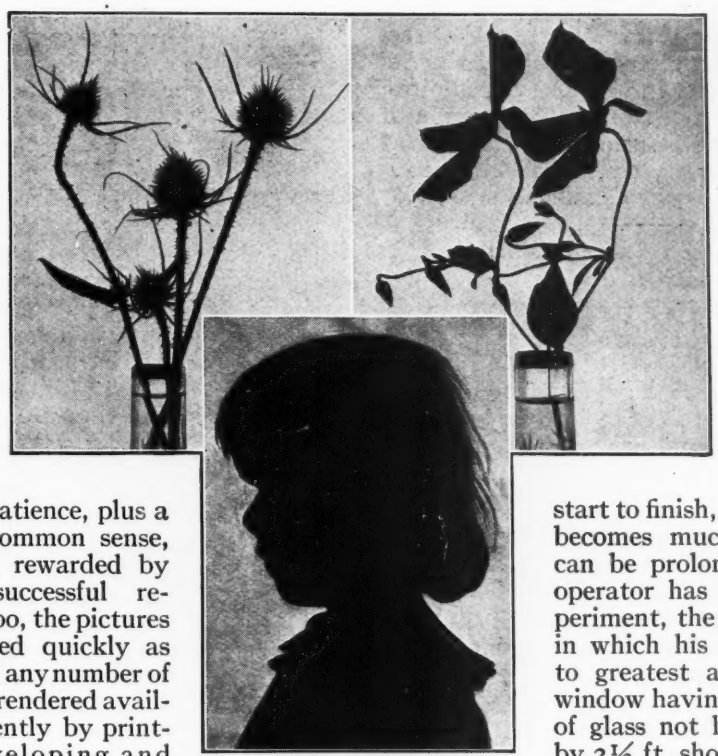

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On the whole the shadow photographs may be made more satisfactorily by day because artificial light can then be dispensed with from start to finish, while focusing becomes much easier, and can be prolonged until the operator has found, by experiment, the exact position in which his subject shows to greatest advantage. A window having a single pane of glass not less than 2 ft. by 2½ ft. should be chosen. This must not be too high above the floor; if possible it should face north, although this is not essential. To the window-frame a screen of linen or paper may be fixed with tacks or pins. Any transverse light may be shut out by means of blinds or screens. When this has been done, everything will be in readiness. If the day is clear and the light brilliant, a snapshot will be possible; and when children or animals are sitting, this is a great advantage. In dull weather, an exposure of several seconds may be necessary. Everything depends upon the density of the screen that is used.

Every effort should be made to secure vigorous outlines, although all avoidable hardness should be eliminated. Remember

that we are working in outlines almost exclusively, although occasionally some suggestion of translucency may be introduced with good effect. Excellent "still life" studies may be made from flowers and foliage arranged in clear, cut-glass bowls or vases. Obviously, there is a wide choice of subjects, but heavily opaque objects, without beauty of outline to recommend them, should be strictly avoided.

The question of printing out these shadow photographs effectively must be left to personal decision. Sensitized papers are obtainable nowadays in so many varities of tint and surface-texture that the most exacting requirements can usually be met. If the object in view is a close imitation of a real silhouette, it may be gained by using a smooth-surface bromide paper which gives strongly contrasted black and white effects.—PERCY COLLINS.

To Sharpen Skate-Runners with a File

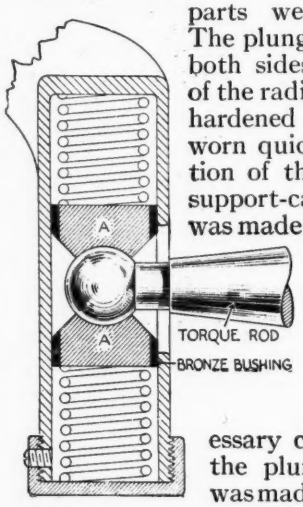
THE following is a good way to sharpen steel skates having soft runners. Take two pieces of soft wood, about 3½ in. long and 1 in. square and fasten them securely 1 in. apart on a workbench or table as shown. Secure another piece 10 in. long, 3 in. wide and 1 in. thick, to the bench-top about 6 in. from the first pieces. Clamp the skates to these cleats the same as you would on the soles of the shoes, and

Clamping skates to a bench-top to hold them securely for filing the runner surfaces

sharpen them with a 10-in. file. File in one direction only, to keep from spoiling the file-teeth. This method is quick, and a much better edge can be obtained by it than by grinding.—GEORGE WASSERBERGER.

Repairing the Torque-Rod Support on an Automobile

THE drawing illustrates how the forward end of an automobile torque-rod is supported. Trouble was experienced at this point on a rather low-priced car, and after examination it was found that the parts were badly worn. The plungers *A*, placed on both sides of the ball-end of the radius-rod, were case-hardened to avoid being worn quickly from the action of the ball-end. The support-casing, however, was made of cast-iron. This being comparatively softer than the hardened plungers, wore a great deal more rapidly. Thus an unnecessary clearance between the plungers and casing was made which was found to be ⅛ in. at some points, and this was the cause of the trouble.



Bushing the sliding parts of a torque-rod

To eliminate it the entire assembly was removed from the car and the casing rebored to a somewhat larger diameter. To allow for this increase, bronze bushings were pressed over the plungers as shown. This repair eliminated the trouble, and gave the added advantage of causing the wear to be carried by the bushings, which could be readily and cheaply replaced.—ADOLPH KLEIN.

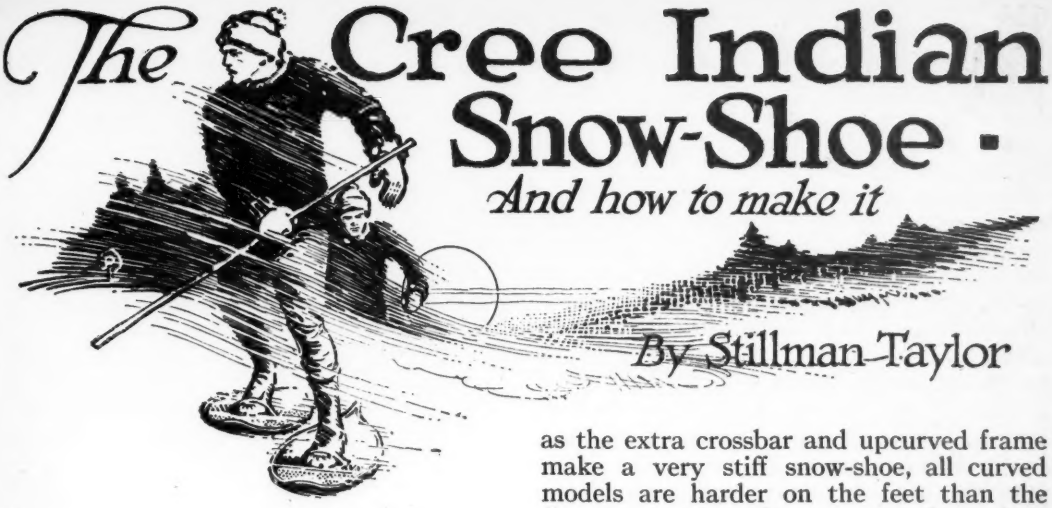
Repairing Molded Rubber Goods with Quick-Cure Cement

THE quick-cure vulcanizing cement is excellently adapted for repairing molded goods and other rubber articles which would not stand prolonged exposure to the heat of vulcanization. Hot-water bottles, rubber boots, bands on date stamps, etc., are examples of articles that can be repaired with this cement.

A Ground Color for Applying Mahogany Stain

DISSOLVE permanganate of potash in sufficient water to make a rich crimson shade. Any kind of white wood may be painted with this solution. When dry, apply the mahogany stain and finish in the usual manner.

The Cree Indian Snow-Shoe · And how to make it



By Stillman Taylor

SNOW-SHOES are made in a large variety of shapes. The particular style described here is the form made and almost exclusively used by the Cree Indians of Canada. As shown in Fig. 1, the shape is somewhat longer and the width narrower than the common Eastern or Algonquin shoe. In fact, the model used is 60 in. long and 12 in. wide. As the frame is made in two pieces, fastened together at toe and heel, this type of snow-shoe is the easiest of all forms for the amateur to make, because the one-piece frame must be well steamed before the stick can be bent to form the usual curving bow.

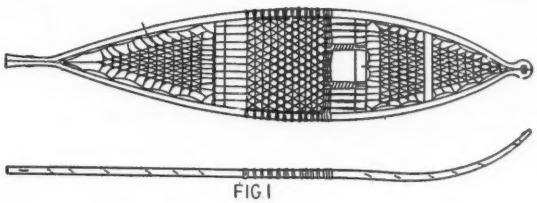


FIG. 1

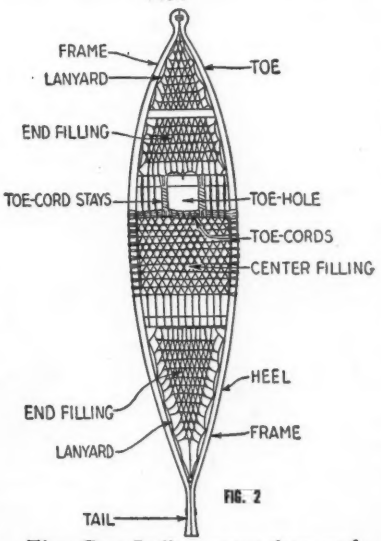


FIG. 2

The Cree-Indian snow-shoe and the names of its component parts

The Cree makes his shoe with an extremely high upcurved toe, sometimes carrying it up as much as 8 in. This makes it necessary to construct the frame with a very long and narrow toe, otherwise the highly elevated toe would strike the knee and interfere with the usual stride when walking. The high curve also requires an extra crossbar across the frame to give the necessary curve to the filling. But the high curved toe is bad for hill climbing, and as the extra crossbar and upcurved frame make a very stiff snow-shoe, all curved models are harder on the feet than the flat shoes. To make a more springy shoe, the frame may be made quite flat. The proper names of the different parts of a snow-shoe are given in Fig. 2.

The Frame Construction

The best material for the frame is straight-grained ash. For the average boy a snow-shoe 40 in. long and 10 in. wide will be found the most useful. The average man will find the 60-in. by 12-in. wide model thoroughly satisfactory. The complete dimensions for a good frame are given in Fig. 3, and a study of this drawing will show how to taper the frame correctly. After making the two sticks, which must be exactly alike, two pairs of holes are bored in the toe and heel, and the frame laced together with rawhide thongs. The frame should now be thoroughly soaked in hot water by winding several thicknesses of burlap around it and soaking the rags. Pour boiling water on the wrapped frame at intervals of 14 or 15 minutes, then let it stand for an hour. This will render the frame fairly pliable, when it may be bent over the drying mold, shown in

Fig. 4. This frame may be roughly put together from any lumber found about a home. Complete dimensions are shown in the figure. Leave the frame on the form for two weeks, when it will have a permanent set in the desired shape.

The exact position for the two center cross-braces is best determined by experiment. Spring them in the frame about 15 in. apart, and balance the frame across the clasped hands between the braces. The shoe should almost balance at this point. Shift the braces so that the heel is about 1½ oz. heavier. This insures the heel of the snow-shoe cutting down, and keeps the toe nearer the surface. The crossbars are 1 in. wide, and ⅝ in. thick. Make them of ash to the shape shown in Fig. 5. Each end of the brace is mortised or let in the sides of the frame. A sharp ⅛-in. chisel will come in handy for cutting the mortise, which must be ¼ in. deep. Take pains to make the ends of the braces a nice snug fit in the mortises, so that the spring of the frame will keep them solidly in position.

The small upper cross-brace shown in Fig. 2, is only necessary when the toe is much up-curved. In the straight or only slightly up-curved model we are making, this brace may be omitted.

After finishing the frame, smooth all surfaces with sandpaper, and slightly round off the top and bottom edges of the frame and the edges of the braces so that

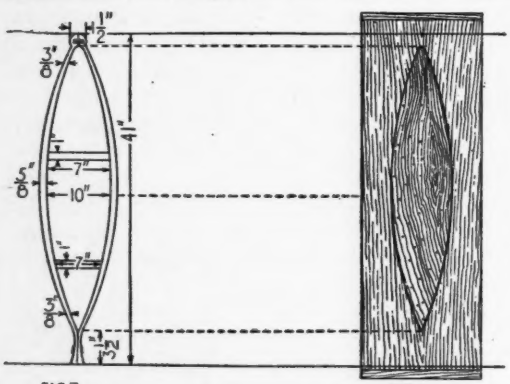


FIG. 3 FIG. 4

Dimensions of the snow-shoe frame and the drying mold over which the sides are shaped

the filling may not chafe across the sharp corners. To preserve the wood, a coat of common linseed oil may be wiped on the wood, but do not put anything else on the frame. Some cheap factory-made snow-shoes are varnished, but no Indian or woodsman would make or use a snow-shoe thus finished, because the frame would prove slippery and treacherous when crossing logs and ice, causing accidents.

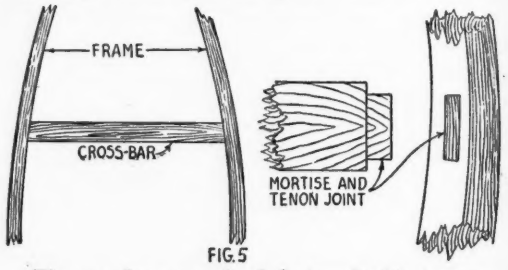


FIG. 5

The crossbars are of ash fastened with tenons to the ends to fit in mortises of the frame

The Indians and woodsmen still fill their frames with deer, moose or caribon hide, but the white man substitutes cowhide for the center and calfskin for filling the ends.

Lacing in the Pattern

Regular rawhide or cowhide belt-lacing is very satisfactory, and this may be purchased in long strips in suitable widths. For the center, use ⅜-in. lacing, and for the toe, heel and lanyards use the ¼-in. width. This may appear a bit wide, but as the thongs are soaked and stretched before use, this will make them very much smaller.

As the leather cannot be well joined with knots, the end of each thong is joined to another by slitting the end of each to form an eye, and the two thongs are joined as shown in Fig. 6. For weaving the strands a lacing needle or bodkin is used. This is simply a piece of birch or maple whittled shuttle-shape about 2 in. long, ¾ in. wide and ¼ in. thick. The bottom side is flat, and the top is convexed and rounded as shown. In the center is an oval hole for the threaded end of the thong. By turning the shuttle slightly, the thong is nipped securely while it is woven and stretched in place.

Cotton cord may also be used for filling the frame. It answers very well where a cheap snow-shoe is desired for occasional use. However, as the labor is the same, it is better to make a hide-filled shoe in the first place, as cord will not stand much hard use. For cord, pick out a heavy twisted or cable-laid fishline for the center, and use a smaller size line for the ends.

As shown in Figs. 1 and 2, the center of the shoe is filled with woven hide laced over the sides of the frame. The ends—toe and heel sections—are not laced around the frame but are woven through a strip of

hide called a lanyard. This lanyard (Fig. 1) is laced through the frame in double holes bored through the sides in practically the same way a tennis racket is strung. About six pairs of holes should be drilled through each side of the frame for the heel-lanyard, and about seven pairs of holes through the upper part of the frame for lacing in the toe-lanyard. Drill the holes clean, and cut a shallow groove between them so that the thong will be slightly countersunk between the holes. In Fig. 6 is shown how to space the holes and make the half-hitch in the lanyard. Start the lanyard in the left hole drilled through the upper cross-brace; lace through the first pair of holes in frame, make the half-hitch shown, and continue up the left side of frame and down on the other side, finishing in the hole from which the start was made. As knots will slip in fastening the thongs, most makers weave back the end of the lanyard through the holes in the cross-brace to keep the end from slipping. The lanyard for the heel-section is placed in the same way as that of the toe.

Filling the Toe and Heel

Every maker of snow-shoes has his own particular way of weaving the hide to fill his frames. Many of the patterns used are quite complicated and would be impossible to clearly explain by word or picture. However, any amateur will, after a little experimenting, hit upon a good method of weaving the strands. As a fairly open or coarse mesh is best for all-around use, the weaving pattern pictured will be found easy and satisfactory whether hide or cord is used.

As shown in Fig. 7, the first strand is started at the lower left corner of the lanyard-loop on the cross-brace. It is carried up to the last loop of the lanyard, twisted around itself and carried down to the first lanyard-loop on the right side on the cross-brace. It is now twisted around itself and carried over to the lanyard on the side, twisted about itself and thence across the frame. As each

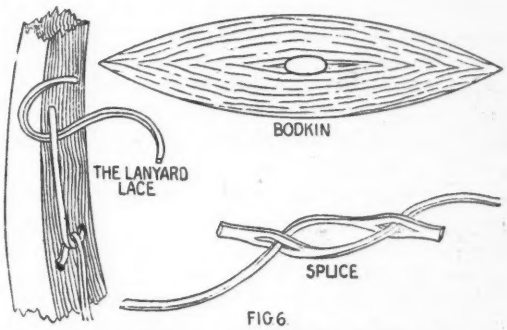


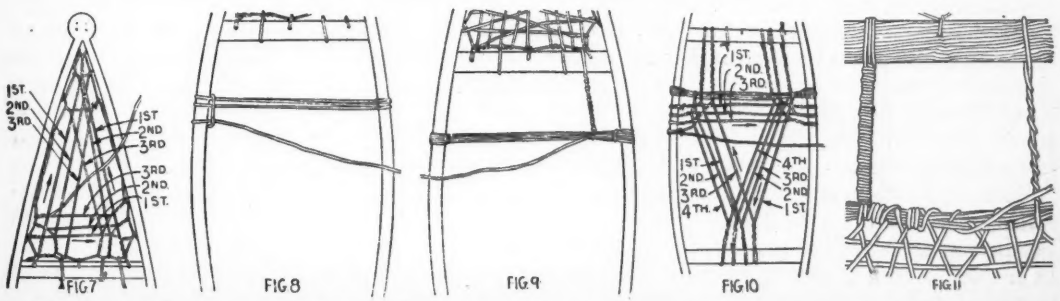
FIG 6.

The method of spacing the holes for the half hitch in weaving the lanyard

strand is marked in the drawing, it will be an easy matter to follow their course. The same method is used from beginning to end. By keeping the drawing beside you, the pattern can be followed exactly.

The strands will be pulled somewhat out of shape while weaving them, but this is easily straightened out from time to time as the work proceeds, by means of a wooden fid. This is merely a round stick of wood about ½ in. in diameter and whittled to a point at one end. The chief thing to keep in mind is to stretch the thongs as tight as possible, and this is done by using the leather strips while wet, and pulling each strand up as tight as possible. The heel-section of the shoe is filled exactly in the same manner as the toe.

The center is a trifle more complicated to weave, but a careful study of Figs. 8, 9, 10, and 11, will show how to do this correctly. While the center may be filled by weaving the thongs in and out in a square pattern, the manner shown in the drawings is a



The different stages in building up the lacing within the frame. The center part is a little more difficult to weave than the toe, but a square pattern can be formed readily if it is preferred

particularly strong and serviceable way, and is not at all difficult.

Begin by putting in the toe-cord first, as shown in Fig. 8. The thongs should cross the frame about six times, so as to form a strong mainstay. As shown in Fig. 8 the common clove-hitch is used for binding the strands solidly together. The end is then twisted around the toe-cord and carried up and over the upper cross-brace, then twisted down and around itself to form the first toe-cord stay or support, which is clearly shown in Fig. 9.

The work of filling the center may now proceed, as shown in Fig. 10. As each strand is numbered in the drawing, the work of filling the frame will be found easy, using the illustration for a pattern.

The toe-hole—through which the toe of the moccasin works up and down in the act of walking—should be about 4 in. wide. Continue filling the center until about a 4-in. space is left, then stop twisting the strands around the cross-brace and weave through the toe-cord. It is important to finish the toe-cord as smoothly as possible, for any knots or roughness here will chafe the feet. All splices should be made as close to the frame as possible, but not on it. If the pattern is followed, the filling will end in the middle of the toe-cord. Weave it through here several times to finish and secure the end.

The toe-hole may now be finished by taking a new thong, and looping it around the cross-brace beside the toe-hole. Carry the end down close to the toe-cord stay, loop it around the toe-cord, then carry back up and around the cross-brace and wind it down over the toe-cord stay, closely wrapping it as shown in Fig. 11. The end is now wound around the toe-cord over to the toe-cord stay on the other side of the toe-hole, which is wound in the same way as the one just made. Secure the end of the thong by weaving in and out between the toe-cord strands three or four times.

The snow-shoe is now finished, and it should be laid aside to thoroughly dry. This must be done in an ordinary room, because the hide will not prove durable if exposed to bright sunlight or if the drying is hastened by putting the shoes near the fire.

The regulation snow-shoe harness, consisting of a leather stirrup for the toe, and the instep and heel-strap, is more comfortable than a thong and when it is adjusted to the foot the shoes may be taken off and put on quickly.

Climbing an Unspiked Pole by Means of a Piece of Heavy Wire

TO CLIMB a pole of any kind that is not fitted with spikes or cleats and where lineman's spurs are not available, or a pole such as a flag pole, where spurs cannot be used lest the polished surface be marred, take a piece of heavy wire and make a loop around the pole about 4 in. larger in size than the diameter of the pole and make a smaller loop in the other end to fit one foot.

Climbing pole with looped end wire

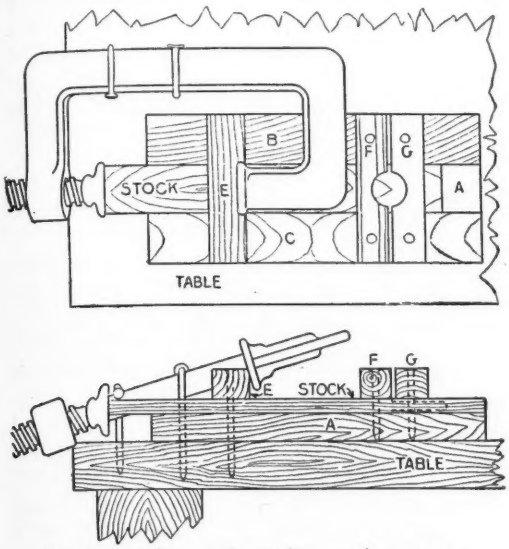
When you clasp the pole with the arms and raise the foot, the loop on the pole will slip up, and when the weight of the body is put on it the large loop will bind on the pole and hold the climber in comparative safety until a grasp is taken higher up on the pole.

Making Tenons on Thin Rails and Slats

IN making tenons on the ends of some slats for the sides of a mission Morris chair, I found difficulty in cutting them out with a saw in the usual manner, because the slats were so thin. The following jig, set up in a few minutes, enabled me to cut perfect tenons ¼ in. thick on material ⅜ in. thick and 2 in. wide, removing 1/16 in. from each side. To a hardwood base-piece, *A*, about 12 in. long and 6 in. wide, two pieces of the same material, *B* and *C*, were nailed on its upper surface, a piece being used between as a gage and the nails driven diagonally to fasten them tight. Crosspieces of material about 1 in. thick and with square edges were then nailed on at *E*, *F* and *G*, the latter two being spaced by the thickness of the tenon saw-blade. An auger-hole 1 in. in diameter was bored as shown to cut halfway in each piece *F* and *G*. The whole was nailed to the work-table near its edge and an ordinary clamp held it in position, the clamp being

fastened with two 3-in. nails driven part way in and bent over.

A tenon-saw with an adjustable back



Jig for gaging and cutting perfect tenons on thin slats with a gage back tenon saw

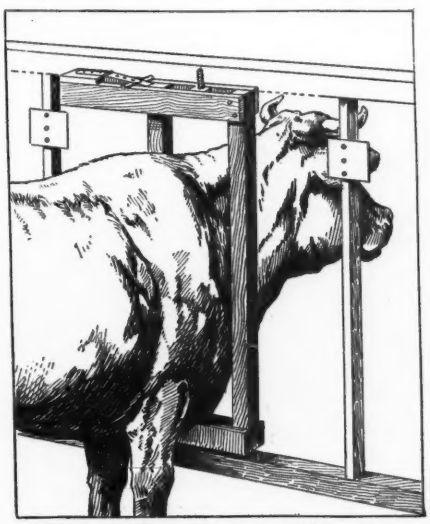
must be used and it is set as follows: Whittle four small pieces of pine 1/16 in. thick and lay a pair of them on each of the pieces *F* and *G* near the opening between them. Slip the saw in the slit and let the back slide down to rest on the pieces. Clamp the back of the saw at the handle and remove the small pieces. The blade will sink 1/16 in. into the pieces *B* and *C*. Take the piece on which the tenon is to be cut, mark the distance for the length of the tenon and draw a fine pencil line with the aid of a square. Insert the slat between the pieces *B* and *C* and under the cross-pieces and drive it in gently with a mallet. When the line drawn passes the saw-guide, as seen by means of the round hole, put a piece of steel the thickness of the saw-blade in the slot—a square blade may be used for this purpose. By means of the clamp, screw the stock forward until the pencil line is just at the edge of the steel; saw until the gage will prevent it cutting any farther and remove the saw from the slot. Drive the stock back until the end is under the saw and make another cut. Give the clamp-screw one complete turn and saw another cut. This operation is repeated until the first cut is almost reached. Split off the bits of wood left between the cuts with a chisel and then with the stock set so that the end is under the slot and the saw in position, begin sawing and slowly screwing the piece forward with the clamp. The result will be a perfectly cut tenon. Each tenon can be cut similarly on both sides.

Generally the tenons used need be only ½ in. long, or even less, and they are cut very rapidly, evenly and not too smooth so that they can be driven home in the mortise. The dimensions of all the pieces used will depend upon the material to be cut and the length of the finished slat. The dimensions given are for making tenons ⅜ in. long on each end of slats 10 in. long, 2 in. wide and ⅜ in. thick.

The same device can be used for cutting tenons on thicker stock, but several cuts are necessary and the channel must be deeper.

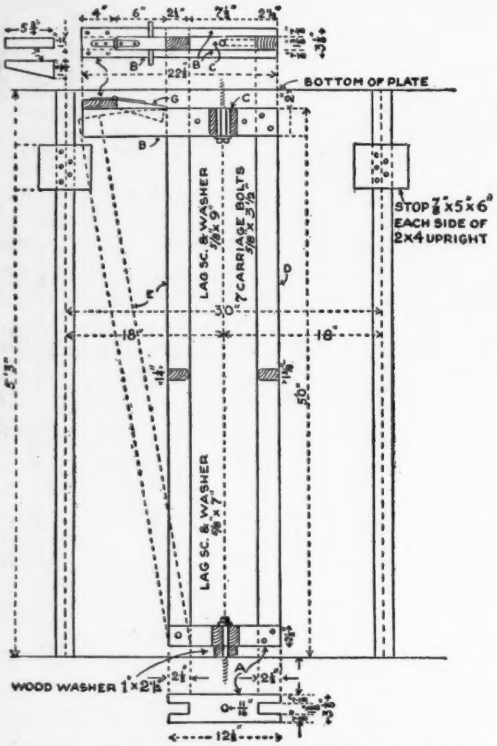
Swinging Stanchion That Gives Comfort to the Cow

THE stanchion described herein has given perfect satisfaction upon a dairy farm in New Hampshire, the proprietor of which devised and built it himself. The old chain-posts were torn out and the new swinging stanchions installed while the cows were in the pasture during the forenoon. The stanchion can be instantly locked from the front or back, and will hold the most unruly cow safe and without discomfort. It will permit enough end movement so that the cow can lie down or get up easily, and allows sufficient freedom of movement in any direction for the greatest comfort. When the cow is lying down the stanchion will accommodate itself to the direction of the neck and there will be no evidence of difficulty in breathing or of the discomfort caused by a



The swinging of the stanchion gives the cow plenty of room for movement with comparative comfort

cramped position of the neck, which is often endured in silence by cows in the rigid stanchion. The pieces necessary for the stanchion can be purchased from a mill


BOTTOM OF PLATE
STOP ¾"x5"x6" EACH SIDE OF 2x4 UPRIGHT
LAG SC. & WASHER ⅜x9"
7" CARRIAGE BOLTS ⅜"x3½"
LAG SC. & WASHER ⅜x7"
WOOD WASHER 1"x2½"

Details of the stanchion showing parts that swing on a lag-screw at the top and bottom

or cut from trees on the farm wood lot. The material list for each stanchion is as follows:

1 base *A*, 12½ in. long and 2½ in. square
1 header *B*, 22½ in. long, 2½ in. wide and ⅞ in. thick
1 header *C* 7½ in. long, 2½ in. wide and 1⅜ in. thick
1 standing side *D*, 60 in. long, 2½ in. wide and 1⅜ in. thick
1 swinging side *E*, 60 in. long, 2½ in. wide and 1¼ in. thick
1 hinge block *F*, 3½ in. long, 4 in. wide and ⅞ in. thick
1 lock *G*, 5¾ in. long, 1¾ in. tapered to 1 in. by 1¼ in. thick
1 washer 2½ in. sq. by ⅞ in. thick with ¾ in. hole
7 carriage bolts 5/16 by 3½ in.
1 lag-screw and washer ⅝ by 9 in.
1 lag-screw and washer ⅝ by 7 in.
1 strap hinge 3 in. and screws ¾ in.
4 screws for the hinge block 1½ in. No. 10

The side pieces may be made of hickory or oak poles 2 in. or more in diameter with their ends trimmed to enter the slots in the header and base.—CHARLES A. KING.

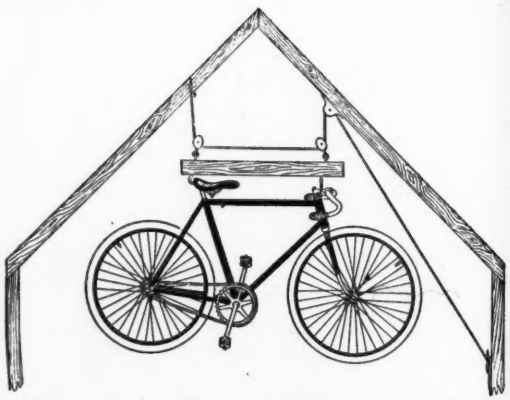
A Writing Ink Made from Discarded Typewriter Ribbons

IF the worn-out copy-ribbon from the typewriter is put in 1 qt. of distilled or rainwater and allowed to stand, it will make a good writing ink. When the fluid is used up, add more water. The record ribbons will not do; a copy-ribbon such as is used to make a letter press copy is the kind to use.

Rope and Pulleys for Hoisting a Bicycle Out of the Way

THE accompanying illustration shows a novel and handy arrangement for putting a bicycle up out of the way. The device will be especially appreciated where floor room is scarce and where a bicycle is to be put away for the winter.

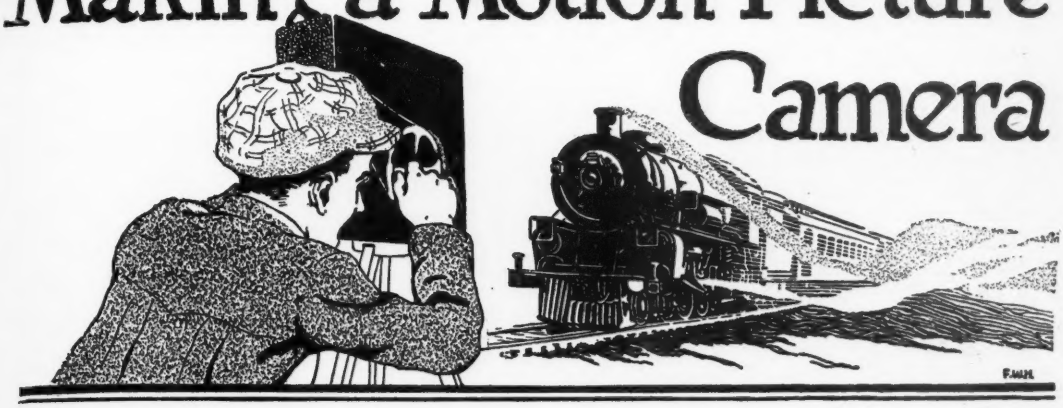
Procure a sufficient amount of small hard twisted cotton cord, 2 small screw-hooks and 3 small pulleys through which the cord will run easily. Fasten one of the pulleys a trifle to one side of the center of the roof and run the rope through it. Cut a small strip of wood 3 in. wide and slightly longer than the distance from the seat on the bicycle to the handlebars. Into the top side of this strip, one at each end, screw the two remaining pulleys with the line of direction of the wheels running parallel with the length of the board. Into the under side screw the two hooks, far enough apart so that one of them will hook into the saddle and the other on to the handle-frame. Run one end of the cord through



Ropes and pulleys attached to rafters for suspending bicycles up out of the way

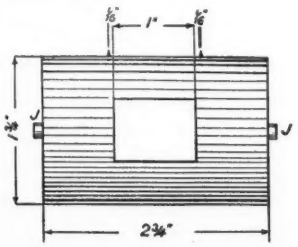
these two pulleys and attach to a similar point in the roof directly opposite the first pulley. To raise the bicycle, simply pull the unattached end of the rope and fasten it securely.—DALE R. VAN HORN.

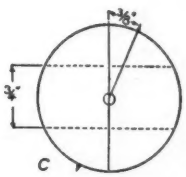
Making a Motion Picture Camera

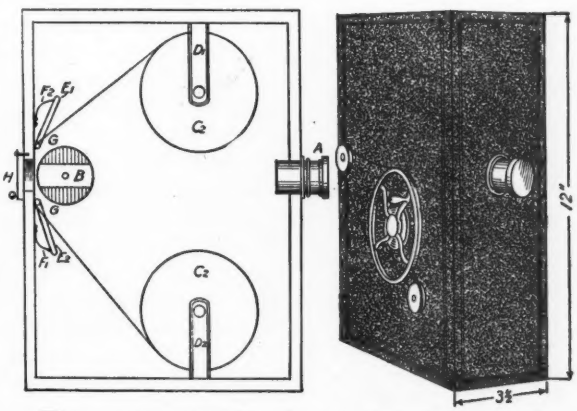


MANY persons would like to make motion-pictures of their friends, but the machines on the market are too high-priced for the average purse. The large companies take, print and project their pictures with separate machines. Following is the description of an arrangement combining all three mechanisms, the chief cost being the lens.

The heart of the machine to be described is the cylinder-shutter and intermittent shifting device shown at *B*, as in detail in the upper left-hand corner of the drawing. It consists of a round wooden cylinder of the dimensions given. Through one of the diameters of this cylinder is mortised a rectangular hole 1 in. by ¾ in. The sprockets or projecting pins *C* are set at a distance of ⅜ in. from the 90 deg. point, using the center of the mortised hole as a base. These pins should fit the perforations in the standard motion-picture film accurately, and the points should be rounded so that they may enter the perforations without difficulty.







The camera consists of very few parts and is used for taking, printing and projecting the pictures

In the drawing of the inside of the camera, may be seen the shutter in position to admit light to the film. The cylinder revolves backward, and the pins engage the perforations in the film, pulling it downward exactly ¾ in., while the light passing through the lens is cut off from the film. After the film comes to rest, the cylinder continuing in its revolution, the light is again admitted to the film through the opening in the cylinder, thus making the exposure. After this the film is again shifted ready for the next exposure, and so on as fast as the cylinder revolves. The usual speed is sixteen pictures per second, which means eight revolutions of the cylinder per second.

The film is taken from the upper roll, supported in the top of the camera box by the bracket *D*1, and after passing behind the spring-actuated roller-guides *E*1 *E*2, it passes downward to the take-up roll, which is connected on the outside of the camera, by means of a belt, to a 4-in. diameter driving-wheel. This belt is left loose, so that it will pull the film only when

it is shifted by the cylinder-pins. The box or case for the mechanism should be about 12 in. in height and 3½ in. wide, the length from front to back being determined by the focal length of the lens.

If it is desired to take an extra-long film at one time the box can be made higher to contain larger rolls. The cylinder is supported by axles J, J, which pass through holes bored in the sides of the camera-box at the proper points to bring the cylinder to within 1/16 in. of the film. To one of the axles is attached a pulley 1 in. in diameter, belted to the drive-wheel with a belt stretched fairly tight. The drive-wheel is made in two sections of different diameters, which are fastened together to form one wheel, the outside section of 8 ins. diameter being belted to the cylinder, and the other section of 4 ins. diameter being belted to the 1-in. pulley connected with the take-up roll at the bottom.

The camera-box has an aperture 1 in. high and 1⅛ ins. long cut in the back, to afford passage for the pins when pulling the film, and to allow using the machine for projecting the pictures. When used as a camera, the opening is made light-tight by the pivoted cover *H*. This is opened to allow the light to be projected on the film when used for projecting the finished pictures.

The camera-lens may be of any convenient focal length. It is mounted in a hole cut in the front of the box, opposite the hole in the cylinder. The lens should be mounted for shifting it backward and forward to obtain the proper focus of the image, as observed on the film through the aperture at the back of the camera. The camera-box must be made light-tight.

Now load the camera with the sensitized film. This must be done in a dark room, with only ruby light. This film can be obtained already perforated from any dealer in photographic supplies. The film is passed behind the pressure-guides and the cylinder-shutter, as shown in the illustration, with the dull or film side toward the lens. It is fastened to the lower take-up shaft by means of a thumbtack, after which the camera is closed. When taking the pictures, the camera should be supported on a table or some other rigid surface. The driving-handle, attached to the driving-wheel, is turned at a speed of two turns per second, making sixteen pictures per second, or eight pictures per turn.

After the film is exposed it is ready for development, which is accomplished in the same manner as the development of ordinary films, except that an arrangement for handling such a long film is necessary.

Make a square wooden frame to fit inside the developing-trays used, which should be at least 14 ins. by 17 ins. in size. The film is wound around the frame with the emulsion or dull side outward and is then easily handled in the developing solutions. The film is left on this frame for all manipulations until dry, when the negative is ready for the printing of the positive film. In the dark room, wind up the negative and an equal length of positive film into a roll, with the emulsion sides in contact. The two films are then passed through the camera together in the same way the original film was passed through in taking the pictures.

For printing, the lens is removed from the front of the camera and the camera pointed toward a bright light. The camera handle is turned at the proper speed to give a correct exposure to the positive film. The correct exposure is best determined by making short exposures on a few inches of film, until the right effect is obtained. Then the full length is printed in the same way.

The positive film is developed in the same way as the negative. After washing and drying, it is ready for projection. The finished positive film is placed in the camera, with the pictures upside down and the dull side toward the back aperture, which is opened. Through it, the light from a stereopticon, or some other form of brilliant illumination, is projected on to the film. The picture is then focused on a screen placed in front of the camera-lens. The pictures are projected by turning the driving handle at the same speed that was used when taking first them.

If a very brilliant light is used for projecting the pictures it is necessary to cover the film when it is not running through the camera, as the film is inflammable and will quickly catch fire from the heat.

An Adjustable High and Low Stool for the Typesetter

A JOB printer who preferred to be seated while setting up type and yet did not relish the inconvenience of jumping off and on a high stool to reach

Two heights for the seat are obtained by merely giving the top a slight turn

the lower drawers, solved the problem with the adjustable stool illustrated.

To make it, four stool tops are fastened together with four floor-pipe flanges, one cross, and four pieces of pipe, all ¾ in. in diameter. Both pairs of pipes are cut and threaded to the same length, two for the high stool and two for the low, the two former being of such length as to make the stool about 24 ins. high and the other pair making one 14 ins.

The flanges are screwed to the underside of the stool tops in the center and the pipe screwed into them. The cross is interposed in the center. When changing from one position to the other it is only necessary to give the stool one-quarter turn and a different height is obtained.

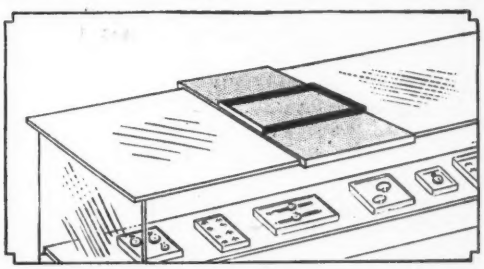
An Easy Way to Remove Old Varnish or Paint

TO properly refinish a piece of old furniture the surface of the wood must be cleaned so that it will present a new and clean appearance. The old varnish must be removed and the wood sanded down and made like a new piece of timber. The most difficult part of the work is to remove the old varnish. Many patented varnish removers are on the market, but where there is just a little work to be done it does not pay to purchase a full can of the liquid. Varnish may be removed by coating the surface with a very hot solution of strong glue, applied thin, and allowing the job to stand over night. The next day the varnish will be found hanging in flakes, and just a little rubbing with fine sandpaper will make the surface clean, leaving nothing but the wood showing. It is then ready to be prepared for the new coat of varnish.

Sliding Exhibit Tray for a Show-Case Top

A JEWELER having a number of long show-cases of the all-glass variety, wished to keep the tops as free from scratches as possible and yet give plenty of free space for showing the goods within the case. He accomplished his purpose by using the sliding tray shown in the illustration. The tray was mounted on a board extending from the front edge of the case to the back. The entire affair was made of light material about ⅜ in. thick, and was constructed of solid mahogany to match the wall fixtures. At the ends of the board and on the underside were fastened two cleats to extend slightly down over the glass top edge. Just back of these pieces and on the underside were glued strips of felt so that the weight of the entire tray and board rested only on the edges of the show-case top.

Within the tray was pasted a square of green baize cloth to give it added neatness. The tray may be made round, square or rectangular, as desired. When

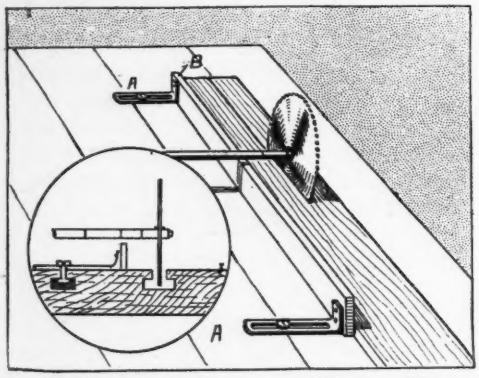


The sliding tray provides a place to show jewelry without laying it on the glass

in position on the case top it can be slid along to any place where it is to be used in showing the goods, or it can be lifted entirely from the case and set aside.

Sawing Boards on the Table of a Milling Machine

THE best machine for cutting boards in a machine shop is the milling machine. The guides *A* are made to



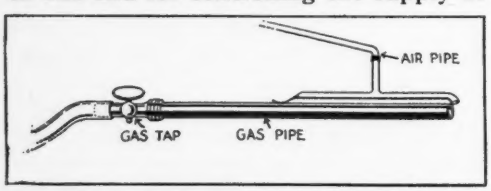
Application of a gage on a milling machine table to guide boards in cutting them

hold the straight edge *B*. These are fastened to the milling-machine table so that the straight edge will guide the board as it is being sawed. By means of the slots in the guides the straight edge can be set so that any width of a strip may be cut from the board. A woodworking saw is placed on the milling machine arbor and the table located so that the saw runs in a T-slot of the bed.

If there is no woodworking saw at hand a large slitting saw can be used and the table swung at an angle of ½ deg., if the miller is a universal. This angle will cause the saw to cut a little wider than its thickness and prevent the saw from sticking.—CLARENCE ANDERSON.

Making a Small Gas Blowpipe of Brass Tubing

THE main tube of the pipe is made of a piece of ½-in. brass tubing about 9 in. long with a gas cock soldered to one end for controlling the supply of



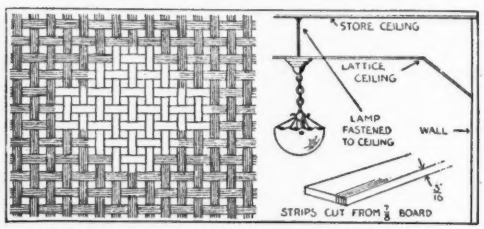
Brass tubing with auxiliary air tube attached for a blowpipe

gas. The air pipe consists of a ¼-in. brass tube, also 9 in. long, cut and formed into a tee, the stem being 3 in. long. One end of the cross-piece is bent at right angles and the other flattened to fit the main pipe where it is soldered. A piece of rubber tubing is used to make connections between the gas cock and the gas jet. Another piece of small tubing is fixed to the air pipe.

A False Ceiling of Lattice Work for Ornamental Purposes

ONE photographer making post-card pictures leased a room that had a high ceiling, and as he desired to have a small room in the front part of the store, it was necessary to reduce the height in order to get a good effect. So he decided to construct an intermediate ceiling, and not caring to make it solid, he used lattice work instead of wall boards or panels.

Boards ⅞ in. thick were procured and cut into $^3/_{16}$-in. strips at a mill. These were woven together the same as any lattice work, making the spaces as wide as the strips. After placing the lattice and a border slant in position it was stained in colors to give a figure effect. The illustration shows how the figures were made, with the shaded portion in a



The lattice as it appeared after being stained and placed in position for a ceiling

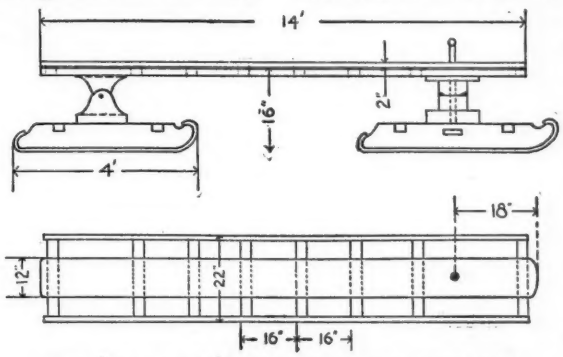
dark color and the light part of a shade to harmonize. There is also shown the method of hanging the electric fixtures to make them appear attached to the lattice work.

The strips being thin are very easily woven into place. The long pieces are spaced on a floor, or rack, made of boards and set on saw horses. They are then fastened temporarily at one end with nails, or, better still, loosely with screws. The "weave" is then inserted by pulling up each alternate "warp," and fastening it temporarily with small nails driven through the strips at the place of crossing, but not far enough to enter the work table. This will hold them in place until a whole ceiling or border width is made, when it can be fastened in the allotted place on the wall.

·A COASTING BOB·

A SPEEDY coasting bob which is large enough to accommodate several passengers has ever been a favorite with boys wherever snow falls. The sled illustrated is an especially good design in that it is a fast, smooth runner, strong and serviceable but not too heavy to be pulled up grade. A careful study of the drawings will make it clear just how the runner is made.

The seat should be made from some light but strong wood, spruce being the first choice. Cedar, pine and hemlock are also good, the preference being in the order named. As shown in the profile sketch and in the scale drawing, the seat is 14 ft. long and 12 in. wide. It should be of selected stock, 1½ in. thick, without large knots or other defects. The cross-pieces which form the foot-rests are sawed from ¾-in. oak, and should be 22 in. long and 3 in. wide. These cross sticks are solidly screwed to the under side of the seat plank, 16 in. apart, as shown. On the upper side of these rests, a strip of oak 1 in. square is solidly screwed to the foot-rests flush with the ends. This serves to strengthen them and also adds to the appearance. At 18 in. from the end selected for the forward end of the sled, bore a hole in the center to admit the steering post, as shown.



The profile of bob and plan of seat board with crossbars for foot-rests and tie-strips at the irends

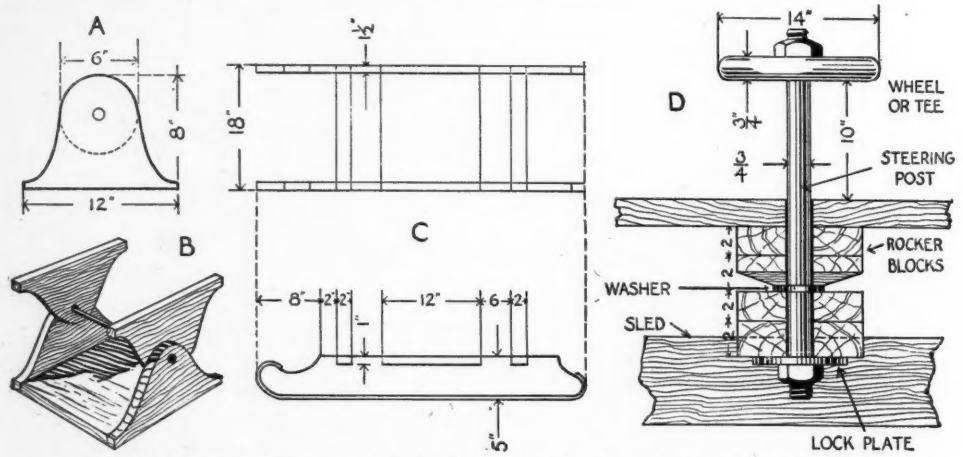
The rear sled is 4 ft. long and 18 in. wide. The sides are made of oak 1¼ in. thick, and should be 4 ft. long and 5 in. wide. The two cross-pieces are of 1¼ in. oak, mortised into the sides and firmly fastened with 3-in. flat-headed screws. The rear rocker-blocks are shaped as shown at *A* and *B* in the drawing on the following page. These should be of 1¼ or 1½ in. oak of the dimensions given. Two pairs will be needed, each pair being mounted to a flat base of oak 1½ or 2 in. thick, 12 in. long and the width of the sled. These curved rocker-blocks are solidly bolted to the base and the latter is mortised into the top sides of the runners and screwed to them, as shown at *C*.

Through the curved cheeks of the rockers a hole is bored and a ⅝-in. iron bolt is run through. This "teeter bolt" construction is the very best method of fastening the rear sled, and is much superior to the usual rigid crossbar type commonly used. The illustration *D* is a kind of X-Ray sketch showing how the two pairs of rockers are assembled—the top pair being bolted to the under side of the seat. The runners are shod with 1¼-in. half-round iron, which is solidly attached to

runners with deeply imbedded screws.

The front sled is made exactly to the same dimensions as the rear sled. The top and the lower blocks should be 8 in. long, cut from 1½ or 2 in. oak, and the post, as shown. This makes a very strong steering gear, which will not work loose with hard use.

That the coasting sled may prove attractive it should be given two or



The rocker blocks and manner of fitting them together to make a teeter; the detail of the necessary parts of the runner and cross-section of the rocker for the front bob

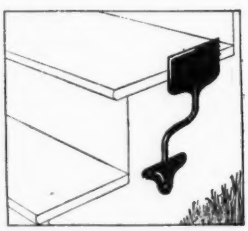
should be the width of the sled and seat respectively. The two middle blocks on the top may run the full width, but will serve just as well if made 8 in. square and the same thickness as the others. The lower half of the first middle block is tapered to a rocker shape, and to make the sled turn easily a large, flat iron-washer is placed between the two. The two upper blocks are solidly screwed together and to the under side of the seat—the centers exactly 18 in. from the forward end. The two lower blocks are likewise screwed together, and the lower one is mortised into the top sides of the sled and screwed firmly to it.

The steering gear consists of a ⅞ or 1-in. iron post, to which is bolted an iron wheel or crossbar known as a tee. If an old brake wheel can be picked up, such as is used on railroad cars, this will make a splendid steering wheel, or lacking this, a crossbar of iron will answer just as well. That the lower end of the steering post may be solidly affixed to the sled, the end of the post is threaded, and a large lock-washer or plate about 4 in. square and ½ in. thick is first screwed on. This plate is provided with four screw-holes in which heavy screws are turned to fasten it solidly to the underside of the lower block which is mortised to the sled runners. A second nut is screwed on the end of

three coats of bright red paint, and finished with a coat of outside spar varnish. The steering post and wheel or tee may be finished with aluminum paint or black enamel. If a cushion is desired, this may be cheaply made of tan khaki, padded with cotton, or an old comfortable may be cut to the desired width to slip in the cover. The best way to keep the cushion in place is to fasten it to the seat with several straps and buckles.

A Shoe-Scraper Made of a Wagon Step

A DISCARDED wagon step screwed to the side of the porch steps makes a good shoe-scraper. It is set off from the steps and the scrapings from the shoes fall on the ground and not on the steps. It cannot clog, and being fastened to the side of the steps, it is not in the way. It does not mar the step nor is it liable to cause injury. Its cutting edge can be filed as sharp as desired, and it will hold its shape and position.



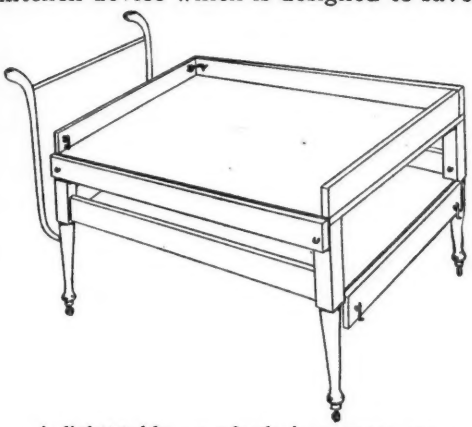
Scraper attached to the side of a step

Simple Means of Removing Tarnish from Silverware

A SIMPLE method for removing tarnish and discoloration from silverware is as follows: Fill an aluminum or porcelain dish with warm water and dissolve in it some sal soda. The tarnished articles should be immersed in this solution for several minutes, when the silverware may be removed, bright and clean.

The Tea-Table Idea Applied to the Kitchen

A BALTIMORE woman, Mrs. Joseph Eiseman, has patented a new kitchen device which is designed to save



A light table on wheels is a great convenience to the housewife in the kitchen

women many steps in the process of dish washing and other household labors.

She had her husband build for her a light kitchen table on wheels, with a handle like that of a baby carriage, so that it could be pushed around the kitchen, just like a drawing-room tea-table. On its four sides the table has a series of hinged leaves, which ordinarily hang flat. When desired, they can be braced upright, which practically doubles the table's size, or again they can be folded entirely upward to convert the top of the table into the bottom of a box having no top.

To the housewife the advantages of this arrangement will be immediately obvious. The table may be wheeled just outside the dining-room door, where the dishes from the dining-room can be placed on it at once. When the meal is ended, the table is wheeled back into the kitchen. There it can be wheeled directly to the sink for the washing.

Quickening the Flow of Oil When Cold

DURING cold weather it is difficult to make heavy oil, such as that used for motorcycles, run out of a small opening. If a piece of ¼-in. copper tubing is bent in a U-shape so that it will go inside the opening and admit air, the oil will run out much faster. If this tube is made long enough to enable one end to be placed in the mouth so that air may be blown into the interior of the can, the heaviest kind of oil can be forced out at the rate of more than a gallon a minute.—NORMAN S. MCEWEN.

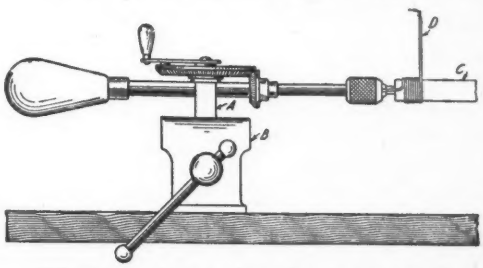
Making sluggish oil flow more swiftly

Using Discarded Range Boilers for Air Pressure Tanks

THOUSANDS of range boilers are thrown away every year, as soon as they become corroded, even in one or two spots. They may be used for air-tanks in brazing, by carefully cleaning the spots where the leaks have been and then soldering pieces of sheet brass over the holes.

How to Make Spiral Springs with Breast Drill

SPIRAL springs can be easily made by means of a small hand drill and a vise. The drill is fastened at the knob *A* in the vise *B*, as shown in the illustra-

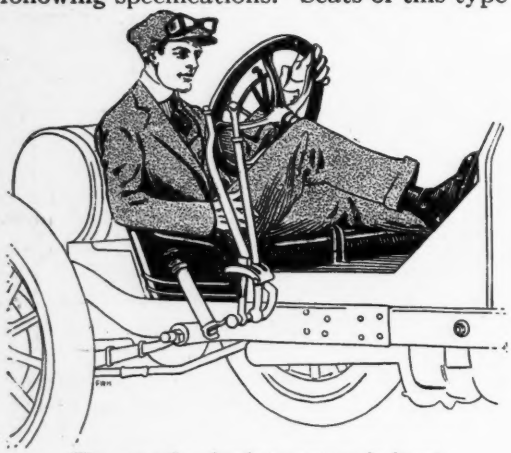


Winding spiral springs is an easy task with a small hand drill held in a vise

tion. A core *C* is placed in the chuck along with the end of the wire. The wheel can be turned with one hand and the wire *D* guided with the other. The core *C* may be any size desired, according to the spring.—JOHN BANSERT.

How to Build Bucket Seats for Automobiles

A THOROUGHLY satisfactory pair of bucket seats may be built from the following specifications. Seats of this type



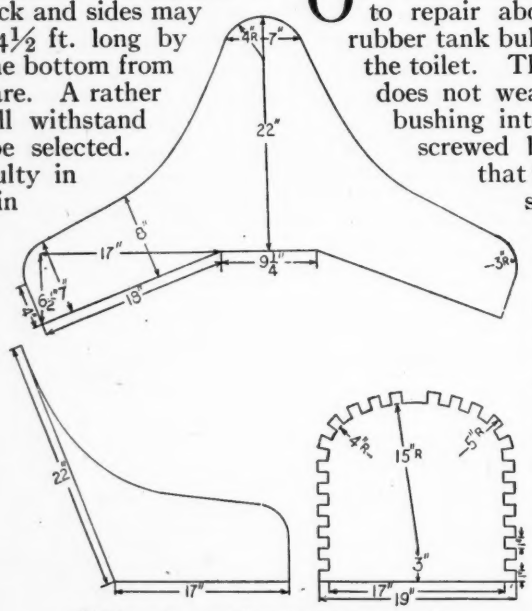
The popular bucket seat as it is applied to the chassis of an automobile

are very popular among sportsmen who are rebuilding used cars into speedy roadsters, as well as with the prominent race drivers, because of their light weight and simplicity and economy of construction.

Two pieces of sheet metal are required for each seat. The back and sides may be cut from a piece 4½ ft. long by 2 ft. 4 in. wide, and the bottom from a piece 1 ft. 9 in. square. A rather heavy metal that will withstand hard usage should be selected.

The greatest difficulty in this kind of work is in obtaining a pattern. The dimensions are given so that they may be laid off with the aid of a rule and a pair of dividers or a compass. These dimensions should be followed closely so that there will be no difficulty in assembling the seat.

The pattern for the back and sides is shown in the drawing. As the bottom lines are very difficult to compute accurately, it is much easier to cut the metal as shown, and then remove the surplus after the bottom is riveted in place. The upper edges are generally folded over or rolled about a wire, to give a smoother and stiffer edge.



Pattern for cutting the sheet metal to shape the seat-back and bottom

A strip 1 in. wide along the lower edge of the pattern for the bottom is folded up to form a means of holding the cushion in the seat. The metal should be first cut to the outside dimensions, and then the pieces between the lugs cut away. The lugs then may be turned up and the bottom secured in the seat by means of rivets through the lugs and the sides or back. One rivet of fairly large size in each lug is sufficient. Large-headed rivets spaced evenly will have a decorative value.

As the metal for this work is usually rather light, braces may be applied to good advantage. A form which is simple and effective may be made from a piece of strap-iron bent at right angles, one end being riveted to the side and the other end to the bottom.

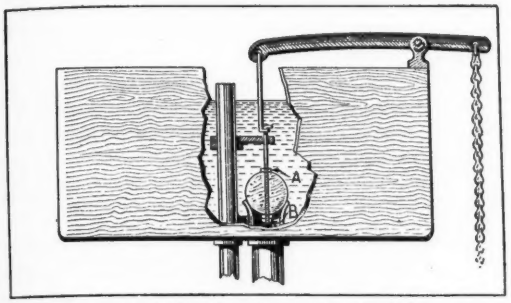
The picture shows a seat of this kind in a converted roadster which has been successful on the track. This is a typical example of the location and appearance of the bucket seats.—S. E. GIBBS.

A Cork Substitute for the Toilet Flush-Box Ball

ONE of the most troublesome devices to repair about the home is the rubber tank bulb in the flush box of the toilet. The rubber bulb itself does not wear out, but the brass bushing into which the stem is screwed becomes loosened so that the bulb does not fall squarely into its seat. This condition will result in leakage.

It occurred to me that a cork ball should serve this purpose as well as a rubber bulb. Accordingly a cork ball was purchased from a dealer in rubber goods and a small hole was drilled through it. A brass rod of the same diameter as the old brass stem was then secured and threaded at one end for a length to equal a little more than the diameter of the ball, which was placed between two nuts, *A* and *B*, with an extra nut at *B*

for a lock-nut. The ball was composed of ground cork held together with a waterproof adhesive and molded into shape. These balls cost considerably less than a rubber bulb. The arrangement worked



A cork ball placed on the flush-box valve wire instead of a rubber ball

perfectly and the lasting qualities of the cork were superior to those of the rubber. A little leakage appeared at first, but after several days the ball had shaped itself to the seat and the joint was water-tight. A small portion of vaseline rubbed on the seat and the ball aids in making the joint close fitting. An accurate record of the lasting qualities may be kept by placing the date of its insertion on the ball with waterproof ink.—L. S. UPHOFF.

Solution for Cleaning Steel Wire

THE wire parts should be run in a tumbling barrel with about 2 oz. of castile soap and enough ground pumice stone to make a thin mud. After the parts are cut down until all rust and scale are removed, they should be washed in hot soap solution and polished by tumbling with soap solution and steel balls; or a fairly bright polish can be obtained by tumbling in dry sawdust with a little flour of pumice.

An Indexing Hint for Readers of Current Magazines

ON looking through a magazine a reader will often see an article of special interest which he would like to read again or one which he would like to call to the attention of some other person. Much time would be saved if a short note were made on the back cover or on the third page of the magazine, or in any other particular spot selected for the purpose. Simply the page number and the name of the person interested with perhaps a word to denote the nature of the article are all that would be necessary; as, for instance: Ernest, see Page 59—Diagram; Frank, Page 64—Mill, etc.—JOHN HOECK.

Why the Tread on Repaired Tires Fails to Stick

TROUBLE is often experienced in getting the tread to stick on small repairs. This may be due to any one of several reasons, the most common of which is that the cement has been applied over wet fabric. The moisture in the fabric, even if very slight will blow the tread loose. Another common cause for loose treads is the failure to roughen up the old carcass sufficiently. In this case the cement will not hold properly and after a few miles of running the repair will separate. It is also well to make sure that proper pressure is being applied to the repair when it is curing.

Photographic Focusing Table for Hand-Cameras

FOR those using hand-cameras with which it is necessary to depend on the scale attached for determining the proper focusing point, the table given is of great value. It is not, however, of value to those who use "box" or other types of cameras having a fixed focus or standard focus. The table is especially designed to determine the proper point on the focusing scale

Distance of farthest point (of object)

Distance of nearest point	2	3	4	5	6	8	10	15	20	30	∞
2	2	2½	2¾	3	3	3¼	3¼	3½	8½	3¾	4
3		3	3½	3¾	4	4¼	4½	5	5¼	5½	6
4			4	4½	4¾	5¼	5¾	6¼	6¾	7	8
5				5	5½	6	6¾	7½	8	8½	10
6					6	7	7½	8½	9¼	10	12
8						8	9	10½	11½	12½	16
10							10	12	13¼	15	20
15								15	17	20	30
20									20	24	40
30										30	60
∞											∞

Table by means of which the average focusing point on the scale may be quickly determined

of the camera at which the pointer must be set when it is desired to photograph two objects, one nearer than the other, and to have both in sharp focus.

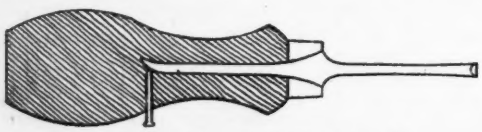
Suppose, for example, a near object is situated 8 ft. from the camera and a far object is 15 ft. away. In order to have both in sharp focus, you must find the figure 8 in the column at the left in the table; then follow across until the column headed 15 is found and the number 10½ will be at their junction, at which the pointer should be set on the focus-scale. This will bring both objects, and all intermediate points, in sharp focus on the plate. If the near object is 5 ft. from the camera and the distant one is 20 ft. the focusing scale should be set at 8 ft. If the near object is 4 ft. from the camera and the far one is more than 30 ft. away, set the focusing pointer at 8 ft. If the near object or point is more than 30 ft. from the camera and the far object is also more than 30 ft., set the focusing pointer at infinity—100 ft. The last figure in the first column is infinity point and the last column of figures in the table gives the focusing points when the far distant point or object is more than 30 ft. from the camera.

Following is the explanation of the formula to find the focusing point mathematically. Two times the far distance multiplied by the near distance will give the number which should be divided by a number found by adding the far distance to the near distance. The result is the focusing point.—GEO. H. STIPP.

Fastening Brad-Awl Blades Securely in Handles

WHEN used for boring very hard wood the blade of a brad-awl is apt to stick in the work so that the handle is pulled from it. This can be overcome to some extent by wetting the tang before driving it in the handle. This will cause a rust which gives a better grip on the wood fibers.

Another and very satisfactory way is to secure the blade as shown in the illustration. Soften the extreme end of the tang by heating it red hot in a flame and allowing

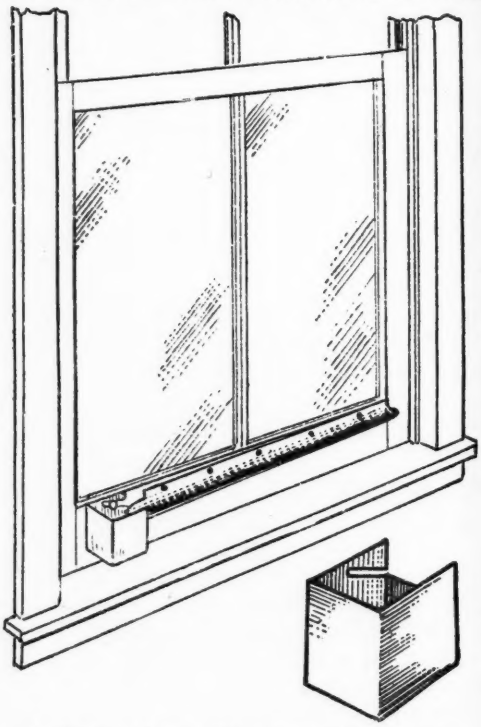


The softened end of the tang is bent over into the wood to hold it

it to cool slowly; then bend the tip slightly to one side. Ascertain how far the tang enters the handle and make a small hole through the side at right angles to the central hole. When the tang is inserted the softened end should just pass the side hole, which is ⅛ in. down from the end. A small nail or brad driven in the hole will bend the tang into a hook where it will be imbedded in the wood. The projecting end of the brad can be filed flush with the wood.

Preventing Melting Frost from Dripping on Window-Sills

WHEN windows covered with frost are heated, the water drips to the sills and sometimes ruins the finish. The same is true when a room becomes filled with



Metal trough on bottom cross-piece of sash to catch drippings from melting frost

steam. To avoid this condition, fasten a small trough just below the pane, with one end slightly lower than the other. A small can or other receptacle may be attached to the nail used at the lower end, to receive the water.—EDGAR MORGAN.

To Sharpen a Reed for a Clarinet or Saxaphone

THE reeds used for clarinets and saxaphones must always be trimmed to take off the rough edge or to make them stiffer. It is almost impossible to do this

perfectly with a knife or shears; but two new coins, preferably five-cent pieces, may be used with good results for the purpose. Place one on the top and the other on the bottom of the reed where it is to be trimmed. The coins should be perfectly even, above and below. Hold them tight with thumb and finger, with the reed between. Now light a match and burn off the end that projects. Run the finger over the burnt end and take off all the ash. This leaves a perfectly smooth round edge.—W. C. Loy.

Gluing Leather, Cloth, and the Like to Metal Surfaces

WHEN undertaking to glue leather, cloth, labels, etc., on metal, it may be difficult to get the articles to stick. Where it is possible to completely wrap the metal, the following is a good plan:

Cut a piece of print or newspaper, wide enough to go a little more than twice around the metal. Paste this up, allow it to soak a moment, then wrap it tightly around the metal, pasted side in. In drying, the paper contracts and pulls itself so tight as to form almost a part of the metal itself, which is then ready for use. If this plan is not practicable, try this:

To 3 parts liquid glue add 1 part glycerin. Glue up the leather, cloth or labels with this preparation and apply directly to the metal. The glycerin prevents the glue from becoming perfectly dry by absorption or evaporation, holding the labels, etc., to the metal by capillary attraction.

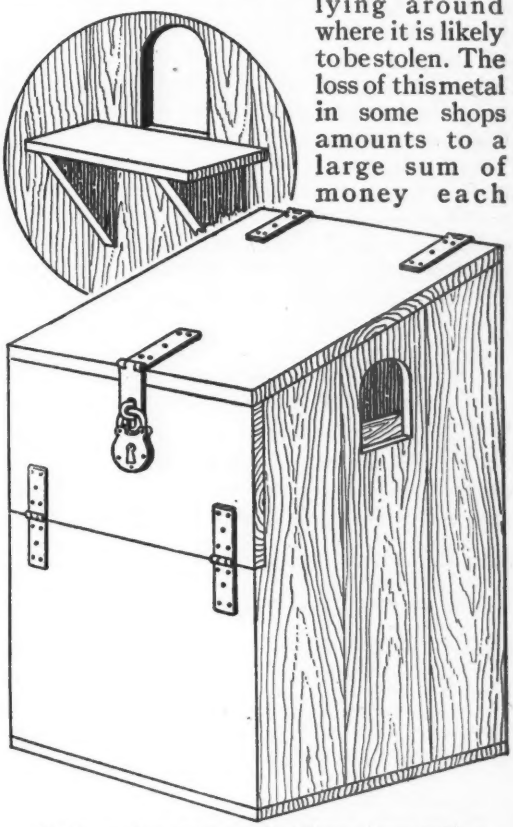
Thawing Frozen Water-Pipes with an Electric Current

WHERE alternating current is available, frozen pipes may be thawed by the use of a special transformer that has a large waste of magnetic energy, or with a choke-coil in series with each coil of an ordinary transformer. The secondary voltage is usually low, but the current is high. The large magnetic leakage, or the choke-coils, permits the secondary of such a transformer to be short-circuited for several moments without injury. The piece of frozen pipe is made a part of the secondary circuit, the primary terminals of the transformer are connected with the lighting circuit, and the voltage is adjusted until the desired current through the pipe is obtained. There should be the least possible resistance in the secondary circuit; in other words, the secondary leads should be of ample size and as short as possible. Connections can be made with a hydrant and a faucet in a neighboring house, or with two faucets in two adjacent houses.

Where only direct current is available, a motor-generator, or a dynamotor is necessary to reduce the voltage. A motor-generator is preferable, since the voltage is under better control. The volts, amperes and time required to produce running water in a frozen pipe vary largely and according to no fixed rule. Ordinary house pipes seldom require more than 30 to 50 volts and 500 amperes.

Making a Bin for Storing Scrap-Brass Collected from Sweepings

ABOUT railroad shopyards, machine and car-shops there is always more or less scrap-brass and other valuable metals lying around where it is likely to be stolen. The loss of this metal in some shops amounts to a large sum of money each year. In order to provide a safe receptacle for this material the strong-box shown in the illustration may be provided. There is a hole of suitable dimensions in the end of the box, and a shelf is placed inside of the box about 12 in. in front and on both sides of it. This shelf makes the removal of



A bin or box to prevent thieves from taking out expensive scrap-metal from the shop-yards

the material a difficult proposition. The shop cleaners deposit the metal in the box as it is gathered. To provide for easy removal a door is placed on top of the box and also one in front, both being locked with a key.—J. R. MINTER.

Coloring Electric Globes for Decorative Lighting

TO color electric-light globes, make a coating as follows: Remove the gelatin from a quantity of discarded photographic films and dissolve them in equal parts of ether and alcohol; then color with aniline. This makes a coating that is impervious to water. Another method is to soak a small portion of gelatin in cold water until it has taken up all the water it can hold, pour off the surplus and add some boiling water—just enough to melt it—then strain it through several folds of cheesecloth. While still hot add a little aniline color, previously mixed in a very little cold water. Dip the globe in the warm solution and allow it to cool in a vertical position to insure even coloring. This coating is not as good as the celluloid process first mentioned.—A. ASHMUND KELLY.

Estimating the Cost of Painting a Detached House

WHEN a house is to be painted the following plan will be found useful in determining the area to be painted and the cost of materials and labor:

Sides and ends 26+26+26+26=104 ft. around the house. Height at corners, 16 ft., multiplied by 104	1,664 sq. ft.
2 gables, 26 ft. wide multiplied by half the height (6 ft.)	312 "
Dormer 2½×9 ft.=22 sq. ft. 2 bay window ends 3×8 ft.=48 sq. ft.	70 "
Side porch, rail and spindles (figure solid) 2½×4 ft.=10 sq. ft.; 2 sides	20 "
2 newel posts, 16 in. around; call it 1½ ft.×5 ft. high	15 "
Front porch floor, 8×23 ft.=184 sq. ft. Ceiling (figure solid) 8×23 ft.=184 sq. ft.	368 "
Front porch rails and spindles. (figure solid) 2½×16 ft.	40 "
Front steps, risers and treads, 5 ft. up×5 ft. wide	25 "
4 porch columns, 4 ft. around×8 ft. high	128 "
Cornice facing and eaves overhang on all sides 3½ ft.×115 ft. around=	402 "
TOTAL	3,044 "

White or light tinted paint required (1 gal. covers about 350 sq. ft., 2 coats); divide 3,044 sq. ft. by 350=8½ gal.

Darker colors (1 gal. covers about 400 sq. ft., 2 coats); divide 3,044 sq. ft. by 400=7½ gal.

An average painter will brush on well about 150 sq. ft. of paint per hour, 1 coat. Divide 3,044 sq. ft. by 150=20.29 hours; call it 20¼ hours for 1 coat, one man, and 40½ hours for 2 coats. Add 3 hours for mixing colors, setting and moving ladders, etc. Total 43½ hours.

Measurements for a house from which to obtain a base for figuring cost of labor and materials for painting

MATERIAL COST:

100 lbs. white lead			
bulk	2¾ gal.,	at	$.....
Pure linseed oil	5 "	"	....
Turpentine	¾ "	"	....
Japan drier	½ pt.	"	....
Color	1 lb.	"	....
Amount of paint, 8½ gal.		Total Cost..	$.....
Labor cost, 43½ hours at		cents per hour	.....
		Total	$.....
Overhead expense, add		% (15%?) of material and labor cost	.....
Profit, add		% (20%?) of material and labor cost	.....
Price to Charge Customer			$.....

Figure 3,044 sq. ft. at your regular price per sq. yd. or per square and see how your estimating method compares with the above.

A Knitting Needle Used for Testing Milk

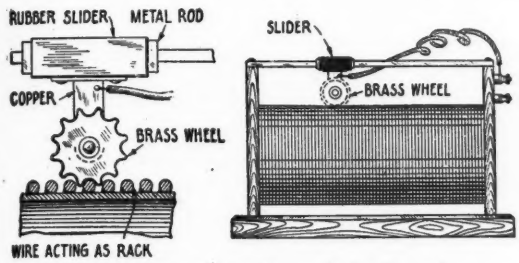
THE purity of milk is tested in Germany in a simple way. A polished knitting needle is held upright, dipped in the milk, and immediately withdrawn. If the milk is pure, some will adhere to the needle; but if water has been added, even in small proportions, the needle will come out perfectly clean.

The Amateur Electrician

And Wireless Operator

A Perfected Slider for Tuning Coils in Aerial Apparatus

A CONTACT for tuning coils that actually slides and does not scrape is illustrated. Ordinary sliders make such unreliable contact and wear out the wire so quickly that they have generally been discarded for the more cumbersome switches. This slider is useful for both



The metal gear-teeth mesh in the wire coils in contact like a rack and pinion

sending and receiving coils, though, of course, the dimensions will be different for each case.

The slider is formed like a gear wheel. The coil-turns serve as a rack, so that the net effect is an almost frictionless direct contact, turn by turn with the coil. Where an ordinary slider makes only line contact by friction with the wire, this slider contacts a larger portion of the conductor. The wire is wound in screw-threads cut in a lathe into a composition non-warping tube, so that the turns can be accurately spaced. The wheel is cut from copper or brass to match the coil pitch, though the less exacting builder may use an old alarm-clock wheel or even a knurled binding-post. A pitch of 20 with corresponding wheel about ⅜ in. in diameter has been found best for receiving coils. For the inner coil of a loose coupler the wheel is arranged to contact through a slit in the tube from the inside, so that the secondary may be moved in or out of the primary.

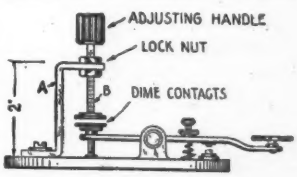
Of course a plain wheel may be substituted, but all of the good qualities outlined will not be retained. This simple improvement constitutes an important betterment of this class of variable coils. This, of course, is equally suited to rheostats and other helical coils. There is substantially no wear on the wire and consequently no short-circuiting of turns by burrs carried over by the erosion of a friction slider.—P. E. EDELMAN.

Fastening Binding-Posts on the Ends of Heavy Wire

TAKE an empty rifle or revolver shell, about a 32-caliber, and through the closed end punch a hole large enough to receive the screw of a binding-post. File the screw off short enough and then push it through the open end of the shell, through the hole in the closed end, and screw the parts of the binding-post in place. Clean the inside of the shell and fill with solder. Insert the end of the wire and heat well over a blow-torch flame. Use soldering flux.

How to Make a Ten-Ampere Key for Wireless

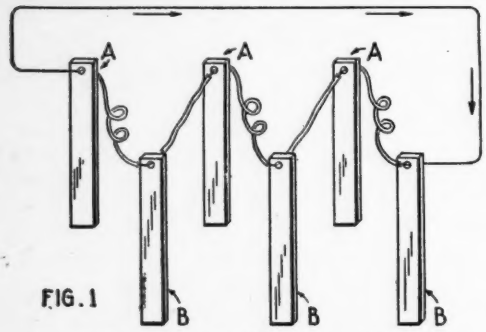
THE contacts of the ordinary telegraph-key are not large enough to stand the current of a fair-sized transformer. But by adding the contacts as shown in the illustration any telegraph-key can be made of ⅛-in. sheet brass bent as shown. The end of the stand *A* is drilled and tapped for a 5/32-in. brass adjusting rod, *B*, which is provided with a lock-nut and adjusting handle. At the end of the screw a small piece of silver—a dime will do—is soldered and another is soldered to the rear end of the key lever, as shown, with a hard solder. The upright *A* should be provided with a binding-post, as the old contacts of the key are not used.—EDWARD JASPER.



Ordinary telegraph-key with silver contacts

Making Photo-Electric Cells to Work from a Light

THE generating of an electric current by the action of heat upon a point of contact of two dissimilar metals,



General principles of the thermo-electricity which is set up by difference in temperature

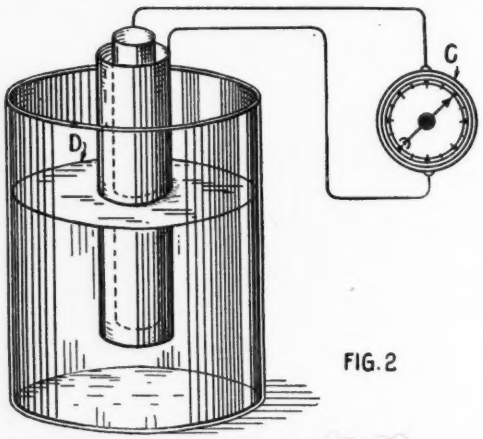
generally recognized by the term "thermo-electricity," is perhaps well known to those engaged in experiments in the field of electricity. The action and general construction of a thermo-electric or "heat" battery, is shown in Fig. 1, in which the points designated by *A* are strips of copper connected in series at the contact points with the iron strips *B*, which are the alternate junctions, the latter being heated or placed in boiling water, while the former are kept cool by immersion in ice water. The arrows indicate the direction of the current, which increases in proportion to the number of pairs of junctions and the difference in temperature of the hot and cold contact points.

That light also possesses this mysterious power of producing an electric current is known to but a few investigators, and perhaps if more widely known would result in a practical research that would add much to our knowledge, and might lead to the solution of the problem as to the nature of electricity. This light method of producing electricity is from what is called photo-electric cells.

A simple photo-electric cell may be constructed by forming two cylinders of tin-foil of such size that one may be placed inside the other, the inner tin-foil being wrapped in blotting paper to shade it from the light. The two cylinders are then immersed in plain water and connected with a sensitive galvanometer consisting of a compass placed over a small coil of insulated wire, as shown at *C*, Fig. 2. Ordinary sunlight or the light from burning magnesium is allowed to fall on the outer cylinder *D*, a current of electricity being set up as shown by the deflection of the compass needle, and flowing from the shaded cylinder to the "light" cylinder.

An interesting and efficient cell of this type has been constructed by Saur and termed the "impulsion cell." As shown at Fig. 3, it consists of a solution of common salt, copper sulphate and water. A plate of silver sulphide, *E*, is immersed in this solution and also a porous pot, *F*, containing a little mercury in the bottom into which dips a sheet of platinum *G*. The glass vessel is then placed in an opaque box as in Fig. 4, which should be closed to exclude all light. On connecting the circuit through a galvanometer a weak current will be set up as shown by the needle.

When, however, one side of the box container is opened and light from the sun allowed to fall on the silver plate, there will be noticed a considerable increase of the current strength, which will decrease with the mere passing of a cloud over the face of the sun, thus demon-



A simple photo-electric cell formed of two cylinders of tinfoil one inside of the other

strating the sensitiveness of the cell. This cell may be put to practical application as a "light-recorder" by connecting through a tracing point running on a strip of lined paper.

It may be of interest to note another "light" cell perfected by Riggollot who used copper oxide plates, 1 in. long by ½ in. wide. The plates were dyed with malachite green which seemed to in-

crease the current strength as demonstrated by his many experiments in this field. On exposing one of the

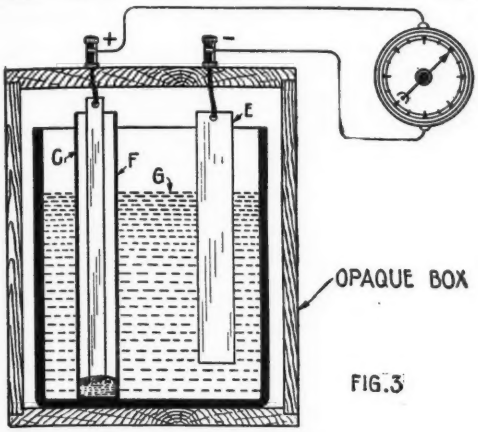


FIG. 3

An impulsion cell which has a solution of salt, sulphate copper and water

plates to a strong light a current was generated, proportional to the intensity and varying with the distance of the light. The peculiar fact was also noticed that on running the exposed plate along the spectrum, that is, exposing it to all the colors of the rainbow, it was positive at the red end but changed to negative as it neared the violet.

As yet, there has been no plausible explanation as to the mysterious relations between heat, light and electricity, yet the phenomena exhibited by these peculiar cells may be more clearly understood by the application of Dr. See's new theory of light which states, that: "The whole theory of ether is abandoned as having no existence, light being caused by electrically charged particles, shaped like eggs, revolving about their axes, and that electricity itself cannot be separated from matter, but always carries matter along with the currents."

There is a fascination about research work in this comparatively new field of photo-electricity which should entice the experimenter who delights in solving scientific problems; for the solution as to the nature of electricity will probably be found sooner or later by the simple application and arrangement of the facts gleaned from a patient scientific research into fields, which as someone has said, "makes thinner in places, the boundary between the known and the unknown."

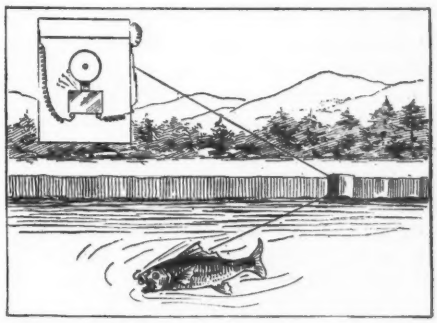
—A. R. MacPherson.

Inexpensive Stranded Aerial Wire Made of Small Copper Wires

COPPER wires may easily be twisted together for antenna conductors by using a hand brace or drill. One end of the strand of wires is fastened to a post or other support, the other end is secured in the chuck of the brace or even merely bound to it with a piece of strong wire. When the strand is stretched out straight and kept a little taut, one turn of the brace for each foot of the total length of the strand will produce an evenly twisted cable.—E. F. Koke.

An Electric Alarm Signal for the Fisherman

WATCHING a fish-line set in the ice, on a bitter cold day is disagreeable, so that the following plan will be welcome. The usual "tip-ups" and "jumping-jacks" serve their purpose nicely, but a more elaborate and interesting device is an electrical signal. A complete outfit may be carried in a box, as easily as a tackle. An ordinary electric door-bell is mounted in a box, and put in circuit with a three-cell flashlight battery. Two strips of spring brass are tacked to the outside of the case. These are also connected, one with a terminal of the battery and the other with a binding-post on the bell. The strips of brass are bent in such a way that a slight pressure on one



When a fish is hooked, the tug on the line causes the contact which rings the bell

immediately brings it into contact with the other. The box is opened, and set near the hole where the fishing-line is led into the ice. One end of the string is tied to one of the brass strips, and as soon as a fish is "hooked" he will tug at the string and bring the strips together, sounding the alarm until removed.

Estimating the Windings of the Electromagnet Coils

IT is frequently desirable to rewind electromagnetic coils to obtain more efficient windings, or to make and wind the coil complete. It is usually difficult to estimate coil-windings correctly, without dealing more or less with complicated technical formulae.

The successful operation of every electromagnet depends upon the number of ampere-turns produced within the winding when a certain current is flowing through it. The value of this current is, of course, determined from the resistance of the coil and any of the apparatus that might be in circuit with it. For example, a certain electromagnet is connected alone in a 4-volt circuit, the coil being wound with 500 turns of wire, giving a resistance of 10 ohms. By Ohm's law, the current C equals .4 ampere.

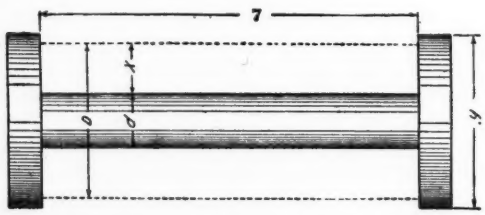
$500 \times .4 = 200$ ampere-turns, which represents the strength or pulling power of the magnet.

It may happen that this pulling power is not sufficient to produce the result desired, in which case it can be increased by either the number of turns or the amount of current in the circuit. By using a larger size of wire, the number of turns may be increased and the resistance reduced, thereby allowing more current to flow, which means a decided increase in the effective ampere-turns. It is not always possible to do this, however, on account of the small winding space available.

In this article we will consider only spools having round cores, these being the ones most generally used. The calculations would be simplified if it could be assumed that the convolutions of the wire were lying together, as if the wire were of square cross-section. Experience has shown, however, that this is not the case. The condition more nearly approached is where the second and each succeeding layer of wire lie in the grooves formed by the preceding layers. To simplify matters, we will take the square of the diameter of the wire as the actual space occupied by each turn, which will be approximately correct and will give good results.

The diameter of the insulated wire can be determined by taking the diameter of commercial bare wire and adding the thickness of insulation, which varies with the manufacture. No fixed values can be given to cover all cases. A number of the leading manufacturers furnish handbooks or cards showing the average diameter over the insulation. The following table of thicknesses for different insulations will be found to give good results:

B. & S. Gage	COTTON		SILK		Enamel
	Single	Double	Single	Double	
0-10	.007	.014	....	....	....
10-18	.005	.010	....	....	....
18-26	.004	.008	.0020	.0040	.0018
26-34	.004	....	.0018	.0036	.0014
34 up	....	....	.0018	.0036	.0009



Unknown quantities are designated by letters and are determined by the formula below

Let

L = Winding length.
y = Diameter of spool head.
d = Diameter of core plus any insulated covering wound over it.
x = Depth of winding.
D = Over-all diameter of winding.

Also let

a = Diameter of wire over insulation.
n = Number of turns.
K = Maximum winding space.

CASE I. Given a spool and the size of wire, to find the number of turns and resistance, it being understood that the coil is to be wound as snugly as practicable. For convenience assume the following values:

L = 2″ d = .4″ y = 1″ Wire = No. 34 enamel.

a = diameter over insulation = .007″ for No. 34 enameled wire.

$.007^2 = .000049$ sq. ins. (space occupied by one turn).

$$\frac{y-d}{2} = \frac{1-.4}{2} = .3 = x$$ or maximum winding depth.

Then $.3 \times 2 = .6 = K$ maximum winding space.

$.6 \div .000049 = 12{,}245$ number of turns.

The diameter of an average turn of wire $= d + x = .4 + .3 = .7$ or

$$d + \frac{x}{2} + \frac{x}{2} = .7$$

As the circumference of a circle $= 3.1416$ then $3.1416 \times .7 = 2.2''$ length of an average turn. As there are 12,245 turns then $12{,}245 \times 2.2 = 26{,}939''$ the total length of wire. As the rated resistance of No. 34 copper wire is .2605 ohms per foot (see standard tables) then the total resistance equals

$$\frac{26939}{12} \times .2605 = 584 \text{ ohms.}$$

As the resistance of any coil will vary (due to atmospheric conditions, heat radiation, etc.), it is necessary to allow a variation above and below the specified resistance. This usually amounts to from two to ten per cent.

CASE II. Given spool, resistance and approximate number of turns, to find size of wire.

Assuming $L = 2''$ $d = .4$ and $y = 1''$, Resistance $= 250$ ohms. The number of turns $n = 4{,}000$.

The simplest method is to assume a certain size wire and proceed to figure what the resistance would be, using the foregoing data. For example, using No. 30 enameled wire and proceeding as in example *I* the following results would be obtained:

$4{,}000 \times (.011 \text{ diameter})^2 = .484$ winding space.

$.484 \div 2 = .242''$ winding depth $= x$. If this winding depth should exceed $.3''$, then wire of this size would be out of the question since the over-all diameter would exceed $1''$ and the windings would project above the spool heads. A safe margin to allow for clearance between the top of the winding and the top of the spool head is $1/32''$ to $1/16''$.

$x + d = .242'' + .4'' = .642''$ diameter of average turn.

$.642 \times 3.1416 = 2.015''$ length of average turn.

$4{,}000 \times 2.015 = 8060''$ total length of wire.

The rated resistance of No. 30 copper wire is .103 ohms per foot. Then

$$\frac{8060}{12} \times .103 = 69 \text{ ohms, which is much too low.}$$

Using smaller sizes of wires and proceeding as before, it will be found that No. 36 is the correct size of wire, although it will take approximately 4,500 turns to get the required resistance. Ordinarily a slight increase in the number of turns will be satisfactory, while a decrease is liable to cause considerable trouble. This is due to the fact that the ampere-turns will be reduced to such a point as to affect seriously the operation of the electro-magnet.

CASE III. Given spool, size of wire and resistance, to find the number of turns.

Briefly the procedure would be as follows:

Estimate the maximum winding depth from the dimensions given, as in Case I.

Estimate the maximum number of turns n from the formula $na^2 =$ winding space $= xL$ or $N = \frac{xL}{a^2}$. As the three letters forming the right-hand side of the equation are known, the value of n can be easily obtained. Calculating the diameter and length of an average turn, and using the value of n found, the resistance can be obtained as in Cases I and II.

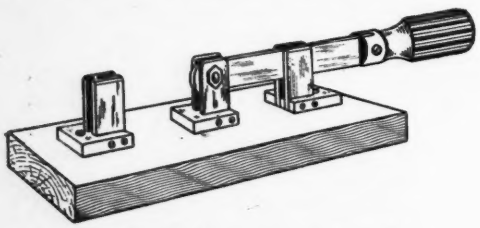
Since this value of the resistance will be above that required (if not, the given size of wire is wrong), the number of turns can be cut down to obtain the specified resistance.—F. H. TILLOTSON.

A Means of Indicating the Location of a Bell Call

WHEN two push buttons operate one bell, it is difficult to judge from which button the bell is rung. If the bell is so connected that when the rear door button is pushed the bell operates on one cell, while the front door uses two cells, the difference in the volume of sound makes the location of the ring easy to distinguish.

An Easily Made Switch for Grounding Aerial Wires

UNDERWRITERS require that wireless antennas shall be well grounded when not in use. To do this, it is necessary to use a switch capable of withstanding

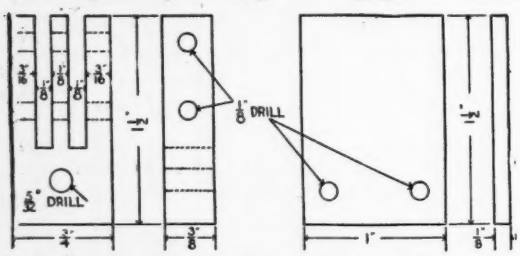


A switch of large proportions for grounding high voltage aerial wires

high voltage. These switches are rather expensive. One can be made cheaply with very little trouble. The material required for its construction is as follows:

18 in. of 1-in. by ⅛-in. copper bus bar.
3 in. of ¾-in. sq. copper bar
Six 1-in. 8–32 brass machine screws
Three 1¼-in. 8–32 brass machine screws
1 hardwood handle
1 piece marble or slate, for base, 4 ins. by 15 in. by 1 in.

With a sharp hack-saw cut the ¾-in. square bar in the center lengthwise and then crosswise, making 4 pieces 1½ in. by ¾ in. by ⅜ in. Only three are used and these are cut as shown in the detail drawing. The 1-in. by ⅛-in. copper bus bar is then cut into a 9-in. strip for the lever and six 1½-in. lengths for the jaws. These fit into the slots cut for them in the ⅜-in. stock. They are held in place by drilling two ⅛-in. holes through the entire unit and putting in rivets. A 1¼-in. machine-screw passing through the 5/32-in. hole,



Dimensions for making the parts for the high voltage single throw switch

holds the jaws firmly in place on the base of the switch.

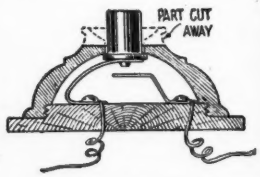
To hold the center jaws to which the lever is pivoted, it is necessary to have an extra machine-screw passing up through the switch-base and into a hole drilled and tapped into the copper. This prevents all possibility of the lever swinging to either side. A ⅛-in. slot is cut in the handle about 1 in. deep. Two machine-screws hold it in place.

The switch should be fastened to the house just outside a window in the wireless room, where it can be reached easily. The antenna is connected to the lever at the center of the switch by soldering the wire into a lug made by flattening and drilling a short piece of copper tubing. In like manner the lead-in is connected to the upper set of jaws and the ground wire to the lower set.

The "ground" should consist of about 10 sq. ft. of a good conductor buried in moist earth and connected to the aerial through the switch by a length of No. 4 copper wire.—HARVEY N. BLISS.

A Floor-Push for Operating the Test-Buzzer

A FLOOR-PUSH is a great improvement over a key or switch to control the buzzer-test, for it is out of the way and leaves both hands free to manipulate the instruments.



Floor push made from push-button

An inexpensive and satisfactory one can be made from a common wood push-button. The flange around the center is cut off so that the button projects some distance above the wood. The push is then connected in the usual manner and operated by motions of the foot.—BRUCE M. MILLS.

The Efficiency of a Wireless Receiving Station

WHEN passing electromagnetic waves set up currents in a tuned receiving antenna, the energy in that aerial system is drawn from the waves themselves. By no means all of the power thus taken from the waves is useful, however, for some of it is wasted in heating the wires, instruments and ground connection. A large part is re-radiated into space; for the antenna carrying radio frequency current acts just like a feeble transmitter even while it is receiving. Only one-half of the absorbed power is used in the receiver.

How to Become a Wireless Operator

V.—Increasing the Range of the Receiver by Tuning

By T. M. Lewis

THE December article of this series gave directions for completing and operating the receiver which was designed for working over distances of about one mile. The apparatus was intended for use with the small transmitter which was described in the October number of the POPULAR SCIENCE MONTHLY; when a larger transmitter is used, the possible working range is, naturally enough, considerably greater. It is necessary for each receiver to be adapted for the wireless waves sent out by the transmitter to which it is listening, however, if the best results are to be secured.

Production of High-Frequency Oscillations

Every transmitter for wireless telegraphy which is permitted to operate under the present radio laws must send out what is called a pure and sharp wave. That is to say, the sending apparatus must be so adjusted that its radiation has a single and definite wavelength or frequency. The main purpose of the regulations insisting upon this condition of sharpness and purity of wave is to enable a receiving station to "tune-in" a sending station without interference. Senders which emit waves neither sharp nor pure are the cause of interference, and sometimes prevent all other stations in their neighborhood from working effectively.

To understand this matter of tuning, one must realize first of all that the currents in a wireless telegraph antenna are of the high-frequency alternating sort, which change in direction very rapidly. In a simple transmitter, with the spark-gap directly in series between the antenna and the ground, as described in the October and December articles, the effect of the induction-coil is to charge the aerial by storing in it a quantity of electricity just before each spark takes place. The induction-coil secondary tries to charge the antenna up to its maximum pressure, or to drive into it all the electricity possible. Before this top-point is reached, however, the spark-gap breaks down and the charge of electricity rushes across it to the ground. Because of the electrical property of the aerial wire (and of the coils in series with it) called inductance, the charge overshoots itself somewhat, and the antenna is left charged in the opposite direction for an instant. Therefore, in the natural attempt to restore equilibrium or electrical balance, the charge rushes back out of the ground into the aerial; this time it overshoots also, but not by so much. The electrical energy thus oscillates back and forth, like a swing left to itself, until it is all used up in radiation, or in losses in and near the circuits.

Period and Frequency

A certain amount of time is required for the electrical charge to travel from the top of the antenna to the ground and back again, just as a certain time is required for a pendulum to swing from one end of its beat to the other and back again. This amount of time, measured in seconds, is called the *period* of the oscillation. The longer the wire, the longer the time for each trip of the current, and the longer the period. The number of times the electrical charge makes the round trip in one second is called its *frequency*, and this of course may be calculated by dividing the period, in fractions of one second, into one second. For example, if the period of oscillation of an antenna is one millionth of a second—which merely means that the charge takes that long to travel up and down the antenna once—the frequency is one-millionth second divided into one second, or one million. This is the number of trips the charge will make in one second.

Wavelength

Knowing the frequency of any electrical oscillation or high-frequency alternating current, one can immediately compute the *wavelength* which it will produce if it flows in a suitable wireless-telegraph antenna. The rule is simply to divide the frequency per second into three hundred million. The answer to this little problem in Arithmetic gives at once the wavelength in meters. For example, taking the frequency of one million per second quoted at the end of the paragraph immediately above, it is

found that the corresponding wavelength is three hundred meters. The following table of frequencies and wavelengths will be helpful.

TABLE I.

Period in Seconds	Frequency Per Second	Wavelengths in Meters
0.00000033	3 000 000	100
0.00000066	1 500 000	200
0.000001	1 000 000	300
0.000002	500 000	600
0.0000033	300 000	1000
0.0000066	150 000	2000
0.00001	100 000	3000
0.00002	50 000	6000
0.000033	30 000	10000

As the frequency of the sending current varies, the wavelength increases or decreases with it

From an examination of this table it becomes very clear that as the period is increased, the frequency decreases and the wavelength increases. Remembering that the longer the antenna wire, the more time it takes for the charge to pass from the top to the bottom and back again, or the longer the period, it is easy to see that the longer the aerial wire (including the coils connected in series with it), the greater the wavelength will be. As a matter of fact, the fundamental wavelength of a simple aerial, which is its wavelength without any coils in series, is about 4.2 times its actual length measured from ground to top end. To use this rule, both height and wavelength must be measured in the same unit. A table showing the fundamental wavelengths of several heights of plain vertical antenna wires is given in the next column.

The table is strictly applicable only to plain vertical antennas without any loading coils, but it may be used for the approximate fundamental wavelengths of L-shaped antennas if the total length of a single wire is used instead of that of the vertical lead alone. If the antenna is T-shaped, the length from the ground to the center of the flat-top and from there to one end should be used. The two parts of the flat-top should have the same length, as measured from their junction with the vertical lead. Where several wires are used in parallel, whether in a horizontal or vertical antenna, the length is taken as that of one of the wires, and not of the total amount of wire in the aerial system. Neither Table No. II, nor the simple rule must be used when loading coils are connected; for the wire on such coils is much more effective in increasing the apparent length of the antenna than is the straight-away portion.

Tuning

The bearing of the foregoing discussion upon the adjustment of the receiver's tuning to get the greatest distance becomes clear on considering that, for this to be obtained, the receiving set must be adjusted "*in tune*" with the wavelength it is desired to receive. In the simple wireless set described last September, some small degree of tuning was secured by making the antennas and the tuning-coils alike at the sending and receiving station. This receiver, as shown in Fig. 3, has the detector right in series between the aerial and ground connection. The result of this arrangement as regards tuning is that the high resistance somewhat spoils the sharpness of adjustment. If one makes material changes in the length of the aerial wire, or in the number of turns of coil used, a weakening of signals is noticed. The tuning is neither critical nor "sharp," however, and even approximate adjustments will give about as good results as exact ones.

When the receiver described in the December article is used, as shown in Fig. 4. the adjustment is much more accurate. Here the detector is removed from the antenna circuit, and the aerial is connected directly to ground through a loading-coil. As a result the effect of the coil is considerably increased. It was pointed out that the coils and antennas at sender and receiver should be made exactly alike, if possible, but that if there should be any difference in the aerials the shorter one should have more turns of coil connected in series with it. This was, of course, to make the effective lengths of the two antennas the same, so that they would be tuned to the same wavelength.

TABLE II.

Height (Length) in Feet	Fundamental Wavelength (in Feet)	(in Meters)
35	147	45
50	210	64
75	315	96
100	420	128
125	525	160
150	630	192

The fundamental wavelength of a plain vertical antenna wire increases with its length

Receiving Various Wavelengths

With the senders and receivers limited in their activities to communication between a single pair of stations, it is usually not necessary to provide for variation in the tuned wavelengths of either. That is

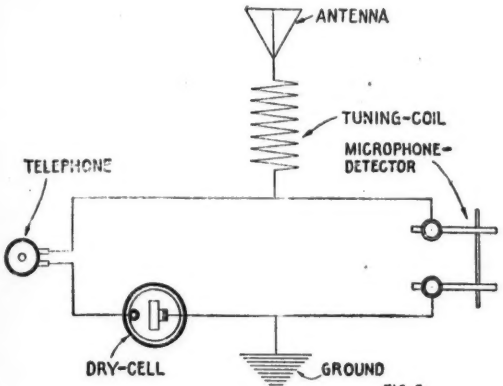


FIG. 3

A simple arrangement which has the detector in series between the antenna and ground

why the simple arrangement of Fig. 2 in the December article could be used. When it is desired to receive from a large number of outside transmitters, all using different wavelengths, it is necessary to provide apparatus whereby the effective length of the aerial at the receiver may be varied to suit the incoming wavelength. A large number of arrangements may be used for this purpose. Some of them tune the receiver very sharply, or in other words make it respond energetically to a very closely restricted range of wavelengths for each adjustment. Other sets of connections are less critical in adjustment, but easier to handle.

The simplest variable tuning instrument for use at the receiver is the so-called "single-slide tuner." This is merely an inductance coil with a sliding contact whereby the number of turns in circuit may be varied at will. It may be used in place of the tuning coil shown in Fig. 3, and will allow some latitude of adjustment, though the tuning is very broad and unsatisfactory. A better mode of connection for the single-slide tuner is that of Fig. 4, in which the detector is put in a side or by-pass circuit; this gives sharper tuning and fairly strong signals.

A still better tuning arrangement fuses the "double-slide tuner," which has two variable contacts. In the catalogs of manufacturers of radio apparatus there are to be found a large number of diagrams showing different ways to connect the double-slide tuner; but the best possible results are to be secured from the arrangement of Fig. 5. One end of the coil is connected to ground, and one of the sliders to the antenna. The larger the amount of coil between the grounded end and this first slider, the longer the effective length of the aerial and the greater the wavelength for which it is tuned. The grounded end is also connected to one side of the blocking condenser described in the November article, and the other slider is connected with one terminal of the crystal-detector also illustrated in November. The telephone has one lead connected with ground, and the other joins the open sides of the detector and blocking-condenser. The test-buzzer, which is not shown in Fig. 5, is to be arranged as explained in the December article, so that the crystal-detector can be adjusted to its maximum sensitiveness without waiting for signals from outside stations.

Operating the Variable Receiver

In working the apparatus set up as in Fig. 5, the first step is to make sure that the detector is adjusted to a sensitive point, and that the connections are all secure and in good condition. Then the slider connected to the detector is set at a position about half-way along the coil, and the antenna-slider is moved back and forth slowly along the length of the entire tuner. When a station within range starts to send, his

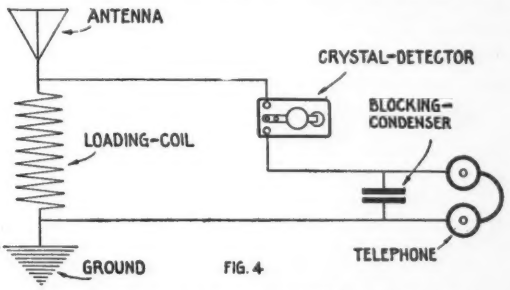
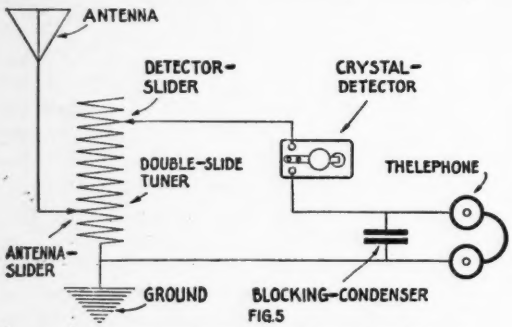


FIG. 4

Connecting the detector around the loading-coil produces a highly selective arrangement

signals will be heard in the telephones; it will be noted that the dots and dashes are loudest with the antenna-slider at some particular setting. Leaving the antenna-slider at this point, the detector-slider is moved back and forth until the position giving the best signals is found. This is the tuned or approximately tuned adjustment of the receiver for the specific wavelength being received.

It often happens with double-slide tuners of this type that there are several positions for both sliders which give good signals for a single wavelength. Therefore it is a good plan to try several settings of the antenna-slider, varying the other contact at the same time; thus one can sometimes find a single pair of settings which give



An arrangement such as this makes it possible to "tune-in" many stations effectively

markedly improved signals. This double-setting effect is more noticeable with other connections than that shown in Fig. 5, but with some combinations of antenna and detector it may be found in this arrangement also. The best thing to do is to have a scale, marked in number of turns or in centimeters of coil, fastened close to each slider, and then to make a tabulation of the best settings for each station as it is heard. Such a table makes it possible to leave the apparatus tuned quite close for any desired outside station, and to feel confident that its messages will be received whenever it starts to send.

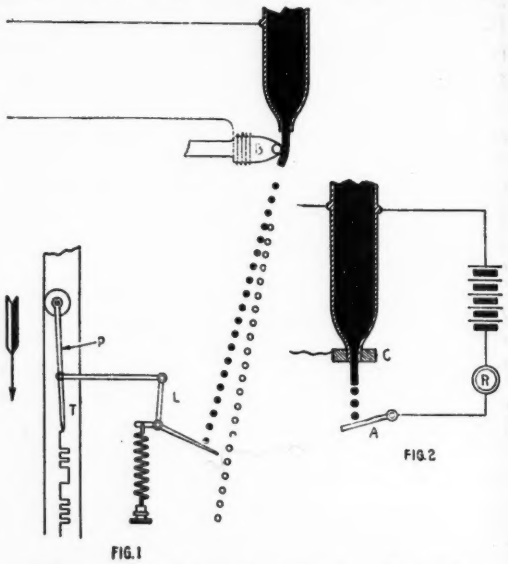
The Apparatus

For receiving long distances it is merely necessary to combine the crystal-detector and blocking-condenser, recently described, with a pair of good head-telephones, a fairly long antenna, and a double-slide tuner, in order to receive at night from commercial stations hundreds of miles away. It is wise economy to buy good telephones; for, as a general rule, the more money invested in them (so long as they are purchased from a reliable dealer) the greater will be their effectiveness. For receiving from amateur stations, which are required by law to operate on waves less than 200 meters in length, it is not desirable to have an antenna longer than 100 feet or so, though longer wires may be used if a condenser is connected in series, as will be explained in later articles. To get the best results from the longer wave stations, such as the commercial plants which use 600 meters and the Naval stations on waves of 1000 and 1200 meters, it is best to have antennas about 200 feet long. Using the ordinary crystal-detector, a double-slide tuner, good telephones and a single aerial wire swung between chimneys 150 feet apart and 40 feet above the ground, it is not unusual to receive messages 600 or 800 miles at night during the winter.

The loading-coil described for the one-mile sender, in the October article, may be used in the diagram of Fig. 5, if two clips are utilized. This will not give a very long range of wavelengths, but will do for experiments. For the best receiving, a modification of the double-slide tuner, which is easily made, will be described next month.

Valdemar Poulsen's Mercury Drop Impulse-Amplifier

THE Danish scientist, Valdemar Poulsen, has brought into the service of wireless, as well as of cable signaling, a new impulse-amplifier which depends for its action upon the globulizing effect of mercury. The explanation of this mercury-



The amplifier depends upon the effect of a current on the cohesion between molecules

globulizing effect is the same as that of the globules of water issuing from an ink-dropper. It is the attraction of the molecules for each other that tends to balance the tendency of the water within the drop to break through the surface. Naturally

a water-particle well within the drop would be attracted from all sides, and hence the fluidity of the drop would not be affected. But the surface molecules would have no balanced attractions because the body of the water-drop is within the surface. Consequently the surface particles are pulled inward toward the center of the water, producing a tension at the film of water at the surface so that it is capable of supporting a certain amount of liquid.

What the Danish scientist has discovered is that even a very slight electric current, passing through the globular supporting-surface or film of a liquid, is sufficient to affect its cohesion. The natural "surface-tension"—as it is called—is strained, and in the case of mercury the globulizing effect is diminished and the mercury becomes more capable of adhering to and netting the surfaces which it contacts.

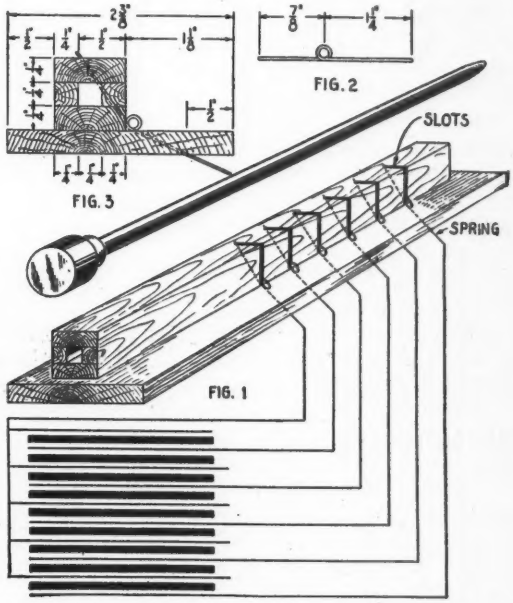
In the form shown in Figure 1, the mercury-jet is brought into contact with a bone-surface *B* which is moistened slightly with a solution of caustic potash. By passing the very feeble electric currents through the wetted bone and thereby through the mercury-jet, the jet is enabled to "wet" the bone-surface to a greater degree than before. Consequently, it is slightly deflected and thereby, by means of a lever arrangement *L*, a very strong amplification of signals can be produced by the pen *P* on the recording-tape *T*.

In another form, shown in Figure 2, a bone-collar *C* is provided, which is made to surround the mercury-jet and to come in contact with it. As is well known, every jet sooner or later breaks up into separate globules because the surface envelope of the mercury-column is able to support only a definite amount of liquid.

The contact arm *A* in the circuit containing the relay *R* is raised upward just until the mercury-column is continuous between the collar *C* and the end of the arm *A*. Then with the passing of the signaling current through the collar and the mercury-column, the cohesion between the particles of mercury being reduced, it is impossible for the jet to hold together as well as before, and the consequence is that the globulization occurs for a smaller column length than before. The circuit containing the relay *R* is interrupted by the spaces between the globules. The relay *R* is so connected to another circuit containing the recording-apparatus (not shown) that a powerful current is produced.

Constructing a Simple Variable Condenser Switch

THE details for a simple variable condenser switching mechanism is illustrated, which, if used with a properly made condenser, will produce good results. A true zero capacity can be obtained with this type of mechanism. It may be used as a separate instrument on a condenser,



Variable switch mechanism for controlling output of a condenser for sending or receiving

or it may be mounted as a part of a cabinet set. In building this apparatus dimensions may be used to suit the needs, as any condenser, either sending or receiving, may be connected on this principle. One size of this form of mechanism is given as an example. The materials necessary are as follows:

2 strips of wood, 5 in. long, ¾ in. wide and ¼ in. thick
2 strips of wood, 5 in. long, ¼ in. square
2½ ft. of spring-brass wire, No. 24 gage
1 piece of ¼-in. brass rod 6 in. long
1 insulating knob to fit brass rod
1 cover for condenser, about 5 in. long
Several finishing nails ¾ in. long

The four long strips of wood are nailed in the form of a square tube, as shown in Fig. 1. If the condenser is to have 10 different capacities, mark the tube into 10 divisions, starting the first mark about 2 in. from the end and dividing the other spaces equally. With this part completed take a hack or scroll-saw and cut into each of the divisions diagonally, so that the cut

will be wedge-shaped, 5/16 in. deep at the top and 1/16 in. deep at the bottom. It is essential that the cut be exactly 5/16 in. deep at the top, and it might be well to use some sort of a guide for the sake of accuracy. In Fig. 3 is illustrated the proper way to make these slits.

With a small drill make 10 holes diagonally through the cover at the same spacing as that of the slots in the tube, so that the drill enters at 1⅛ in. from the top edge and emerges ½ in. from the bottom edge. If a No. 24 drill cannot be obtained make one of steel wire. Make 10 springs from the brass wire by twisting it around a nail and cutting to the proper lengths. The dimensions of these springs are shown in Fig. 2. Insert the springs in the holes in the cover. Then nail or glue the wood tubes to the cover so that the springs slide in the slots. File one end of the brass rod to a point, fit the insulating knob on the other and slide the rod into the tube. This rod should slide easily and make connection with all of the springs.

After connecting the alternate condenser-plates together make a tinfoil-lead to the first spring. Twist the tinfoil to the end of the spring beneath the cover and solder it on by heating gently. By "first spring" is meant the spring 2 in. from the end of the tube. Each half of the condenser-plates remaining should be similarly connected with the other springs. Complete the condenser by pouring melted wax into the case, and attach the cover. If this condenser is to be used in a cabinet set, a hole can be made in the cabinet-front through which the rod may be pulled either way. If a scale is desired on the cabinet-front it will necessitate a change in the position of the condenser and the working of the rod by means of levers.—HARRY RATTNER.

A Quick Method of Removing Enamel from Magnet-Wire

MANY operators prefer enameled wire on tuning coils and couplers but the wire is apt to break when winding coils with the finer wire. To scrape the wire for removing the enamel causes it to break. About the only way to remove the enamel quickly is to pass it through the flame of a bunsen or alcohol burner, which will melt the coating until it runs off. A much slower way is to soak the wire in alcohol until it dissolves the enamel, which is the best method for the smaller wires where they must be measured accurately.

An Easily Learned Emergency Telegraph Code

A TELEGRAPH code which can be learned in a few minutes and which is composed entirely of dots has great possibilities for use in an emergency.

To learn the system it is only necessary to write down the alphabet in its usual order, placing six letters to a line. A to F, inclusive, will constitute the first line; G to L, inclusive, the second line; and so on. The fifth line will be composed of Y and Z only, as shown. Punctuation marks may be assigned to the remaining spaces.

	1	2	3	4	5	6
1	A	B	C	D	E	F
2	G	H	I	J	K	L
3	M	N	O	P	Q	R
4	S	T	U	V	W	X
5	Y	Z	.	,	?	#

Table for learning the dots necessary to send a letter signal

The dots for each letter are ascertained by numbering each with two numerals; first a numeral indicating the group to which the letter belongs and second its position in that group. Thus A is 1-1, B is 1-2, C is 1-3, and so on, to F, 1-6. The second group is numbered similarly from one to six except that the number indicating the group is 2 instead of 1. The second letter in the fifth group, Z, is 5-2.

After a person has written out the alphabet in this manner and set it before him, he can with very little practice spell out any message he may desire to send. For example, the word "radio" would be: 3 dots, short pause, 6 dots (R), longer pause; 1 dot, pause, 1 dot (A), longer pause, 1 dot, pause, 4 dots (D), longer pause; 2 dots, pause, 3 dots (I), longer pause; 3 dots, pause, 3 dots (O).

Amateur wireless operators, boy scouts, miners in distress, mariners, ignorant of the Morse code will find this simple code useful.

For sending numerals, the 10 digits are expressed by dots corresponding to their value, naught being indicated by 3-3.

What Radio Readers Want to Know

Interesting and Instructive Questions and Answers

A 1500-mile Receiving Aerial; Loading Variometer

P. O. Pa., Baxley, asks:

Q. 1. Will No. 14 aluminum wire give about as good results as copper wire in an aerial comprising four wires 100 ft. in length. This aerial is intended for receiving purposes only, for distances of 1000 to 1500 miles from government and commercial stations.

A. 1. There will be no noticeable difference in strength of signals received on aluminum wire from those heard with copper aerial.

Q. 2. My inductively coupled receiving tuner in its present form has a maximum wavelength adjustment of 1500 meters; could I make it adjustable to 2500 meters by means of a variometer instead of the regulation type of loading coil?

A. 2. If the variometer is designed to have a sufficiently large maximum value of inductance it will serve in every way as well as the simple cylindrical loading coil. In addition it will have the advantage of continuous adjustment of inductance, as contrasted to tuning in steps. The best possible plan, however, would be to use a small variometer to allow close adjustment between the steps of inductance in your loading coil or transformer primary, and to make the large jump of inductance needed to go from 1500 to 2500 meters by use of a loading coil of the plain type, with a few large steps tapped off.

Multiple-Layer Tuners for Large Value of Inductance

L. S. D., Fort Worth, Tex., writes:

Q. 1. Is it essential that the loading coils used in the undamped wave audion circuits be wound in a single layer on a very long spark to obtain the maximum degree of efficiency, or can they be wound in more than one layer on a core of short length?

A. 1. Multi-layered coils have proven as efficient as the single-layer coil of great length provided the precaution is taken to separate the layers of the winding from ¼ in. to ½ in. By this method a coil of very small dimensions can be constructed for a very large value of inductance. In fact a coil about 4½ in. in diameter and 6 in. in. length comprising four layers of wire equals the inductance value of another coil 30 in. in length, 6 in. in diameter.

Q. 2. Where can I obtain cardboard tubes as a support for the windings of an inductively coupled receiving tuner to be 6 in. in diameter and 7 in. in diameter respectively?

A. 2. Tubing of these dimensions can be obtained from Ware & Company, Watt St., New York City.

Charging an 800-foot Aerial with a Spark Coil; Intensifying Transformer

Dr. F. C. S., Gwinner, N. Dakota:

Q. 1. Will a 4 in. spark coil charge an aerial 800 ft. long, one wire, for sending; or what is the longest aerial it will charge regardless of wavelength?

A. 1. The longer the aerial wire the larger its capacity, and the more coulombs (quantity) of electricity are necessary to charge it to a given voltage. The output of a spark-coil depends upon so many other constants than its sparking length, especially when the coil is connected with a capacity such as an aerial, that it is impossible to answer your question specifically. The coil should charge the wire you mention to some potential high enough to produce a spark, but better results would doubtless be obtained with a shorter wire.

Q. 2. Can I use No. 36 wire which I have on hand, in building an intensifying transformer for use between two audions which are to be operated from the same battery?

A. 2. Yes, No. 36 wire can be used for the intensifying transformer windings. Make a core 1 in. in diameter by 6 in. long, and fit over it two spools having separation of 1 in. between flanges 4 in. in diameter. Wind each spool full of No. 36 double covered magnet wire, and immerse them in melted paraffin to fill the spaces and prevent damage by moisture. Slip the two filled spools over the core and place them side by side at the center. Either may be used as a primary coil, connected with the plate circuit of the first audion; the other then becomes the secondary and is connected with the grid circuit of the second audion. It is sometimes advantageous to connect only one terminal of the secondary with the grid of the second audion, leaving the other side of the coil open circuited. Which side to connect must be found by trial.

Dimensions of a Transmitting Condenser and Coils

S. F., Whitewater, Wis., inquires:

Q. 1. Please state the dimensions for a mica dielectric condenser for a ½ K.W. transformer having a potential of 13,200 volts.

A. 1. We caution you not to construct a mica condenser unless you can obtain an extremely good grade of mica and have the necessary apparatus for impregnating the plates with an insulating compound. You would do better to purchase copper-plated Leyden jars.

Assuming that your set is to be operated at the wavelength of 200 meters the condenser should have a capacity of about .008 microfarads.

An oil-plate condenser for this purpose may

consist of 12 plates of glass 8 in. by 10 in., covered with tinfoil 6 in. by 8 in. Twelve of these plates connected in parallel will afford the required value of capacity. The foil may be attached to the plates by means of melted beeswax. The plates should be ⅛ in. in thickness.

Q. 2. Will the following described oscillation transformer be suitable for this set? The primary consists of six turns of 5/16 in. edgewise-wound copper strip 5 in. in diameter while the secondary has eight turns of ½ in. edgewise-wound copper strip 7½ in. in diameter. How far apart should the turns be spaced?

A. 2. Provided the turns are spaced ½ in. the transformer will prove entirely satisfactory for operation at the wavelength of 200 meters.

Requirements for License

E. M. K., South Amboy, N. J., inquires:

Q. 1. What are the requirements for securing a license for an amateur sending station?

A. 1. To secure a license for an amateur sending station, the applicant must first possess an amateur first or second-grade license. The examination for this certificate is taken at the U. S. Navy Yard, Brooklyn, N. Y. To obtain an amateur first grade certificate the applicant must have a sufficient knowledge of the adjustment and operation of the apparatus which he wishes to operate and of the regulations of the International Convention of Acts of Congress in so far as they relate to interference with other radio communication and impose certain duties on all grades of operators. The applicant must be able to transmit and receive in the International Morse Code at a speed sufficient to enable him to recognize distance calls or the official keep-out signals. A speed of at least five words per minute, five letters to the word, must be obtained.

After this license has been secured, you must then communicate with the Government Radio Inspector, Custom House, Bowling Green, New York City, who will send you an application blank to be filled out and in which is fully stated the purpose of the station, the character of the apparatus, the size of the aerial, etc. If satisfactory and in accordance with the requirements for amateur stations, a licensed certificate will be given and a call letter assigned in due time.

Q 2. What are the requirements for a commercial license?

A. 2. To qualify for a commercial first-grade license the applicant must pass a satisfactory examination in the adjustment, operation, and care of commercial wireless telegraph apparatus, including the correction of faults and changes from one wavelength to another. He must be able to transmit and receive in International Morse Code at a speed of at least twenty words per minute. He must have complete knowledge of the use and care of storage batteries or other auxiliary apparatus. He must be fully informed on the International Regulations in force applying to radio communication. He must also know the requirements of the Act of August 13th, 1912.

Dimensions of a Short Wave Transmitter

R. P. P., Newark, N. J., inquires:

Q. 1. Please give the dimensions for an oscillation transformer and condenser to be used with a ½ K.W. set and an antenna having a wavelength of 170 meters.

A. 1. The primary winding of the oscillation transformer may consist of four turns of 3/16 in. copper tubing or No. 6 D.B.R.C. wire wound on a form 10 in. in diameter, the turns being spaced 1 in. apart. The corresponding secondary winding may be 8 in. in diameter and comprise 10 turns of the same tubing or wire spaced ¾ in. apart.

The condenser should have a capacity of .008 microfarads and for this you require 12 glass plates ⅛ in. in thickness, with other dimensions 8 in. by 10 in. covered on both sides with tinfoil 6 in. by 8 in. These plates should all be connected in parallel and then immersed in oil.

Long Distance Receptions from Germany

A. T. Valparaiso, Ind., inquires:

Q. 1. Is an aerial 200 ft. in length 80 ft. in height suitable for the reception of undamped wave stations located in Germany?

A. 1. Yes, provided a supersensitive receiving set is employed.

Q. 2. Can I use a sliding wire tikker for this purpose?

A. 2. To collect enough energy for these far distant stations to make audible the signals on a tikker, it would require an antenna of enormous proportions such as used at the large transatlantic and transpacific stations. Some form of the audion oscillating- circuit is required to receive foreign stations on amateur aerials.

Q. 3. Please give a circuit diagram for a long distance receiving set, and data for the construction of the tuner.

A. 3. You had better secure a copy of the November, 1915, issue or the April, 1916, issue of this magazine and note the articles on long distance receiving apparatus. Also in the book "How to Conduct a Radio Club" (on sale by the Book Department of this magazine) there is described fully the circuits of a long distance receiving set with the complete dimensions for all the coils.

Q. 4. This set is to be used in eastern Pennsylvania in a mountainous district. Will the mountains interfere with the workings of the apparatus?

A. 4. Generally, no. Mountains seem to have the most severe effect when they are located near to the transmitting station rather than to the receiving station.

Licensing a Receiver

P. T. P., Salem, Va., writes:

Q. 1. I am about to erect a receiving station and desire to know if it is necessary for me to inform the Radio Inspector.

A. 1. The inspector need not be informed nor is a station license required for a receiving equipment.

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